PROJECT MANUAL

DIG Project No.23.084

Renovation and Addition of the

Union College of Union County

Physical Education Center

1033 Springfield Ave

Cranford, NJ 07016

Owner:

Union County Improvement Authority

10 Elizabethtown Plaza

Elizabeth, NJ 07202

Date:

JUNE 16, 2025

Architect:

DIGroupArchitecture

15 Bethany Street
New Brunswick, NJ 08901
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Vincent Myers, AIA *Date*

NJ RA

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BLOCK 121; LOT 1, 2.01, 2.02, 3, 4, & 5

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REQUEST FOR BIDS

FOR

RENOVATION & ADDITION OF THE UNION COLLEGE OF UNION COUNTY PHYSICAL EDUCATION CENTER PROJECT

This Project is being funded through Chapter 12 Bonds - self-refurbishing capital funding for Community Colleges, where the County issues bonds for the construction and the State shares the debt service equally with the County and from County College Reserves

Issued By:

UNION COUNTY IMPROVEMENT AUTHORITY
10 ELIZABETHTOWN PLAZA, 5TH FLOOR
ELIZABETH, NEW JERSEY 07207

Issue Date: June 19, 2025
Due Date: August 19, 2025

UNION COUNTY IMPROVEMENT AUTHORITY
REQUEST FOR BIDS
RENOVATION AND ADDITION OF THE UNION COLLEGE OF UNION COUNTY
PHYSICAL EDUCATION CENTER PROJECT

PUBLIC NOTICE

~~The~~ Union County Improvement Authority (the "Authority") has issued a Request for Bids (the "RFB") soliciting Bids from qualified entities ("Bidder(s)") for the renovation and expansion of the Union College of Union County Physical Education Center in Cranford, New Jersey (the "Township")

Sealed Bids must be received by the Authority on or before **11:00 a.m.**, prevailing time, on **August 19, 2025** (the "Due Date"). Any Bid received after the Due Date will be rejected. Bids must be delivered on or before the Due Date to:

Union County Improvement Authority
10 Elizabethtown Plaza, 5th Floor
Elizabeth, New Jersey 07207
Attention: Dr. Bibi Taylor, Executive Director

Sealed Bids must be received by hand delivery, mail, or delivery service in accordance with the instructions provided herein no later than the date and time indicated above. The Authority is not responsible for Bid packages received after the time and place designated, irrespective of the date and time the package was mailed, posted, or left with a delivery service. Bidder assumes any and all risk of late delivery of its Bid package. Bid packages not received on time will be returned to the Bidder unopened. Bids must be enclosed in a sealed envelope, bearing the name and address of the Bidder and labeled "**UNION COLLEGE OF UNION COUNTY PHYSICAL EDUCATION CENTER RENOVATION AND EXPANSION PROJECT RFB**".

Details concerning all RFB documents are set forth in the RFB and may be (i) downloaded at no cost from the Authority's website at https://ucimprovementauthority.org/ prior to the Due Date

PRE-BID MEETING: A Pre-Bid Meeting will be held on **June 26, 2025, at 10:00 a.m.** at the College located at 1033 Springfield Ave, Cranford, NJ in room N-4 in the Student Development Building. Bidders are directed to park in Lot #1. Attendance at the Pre-Bid Meeting is not mandatory. However, it is strongly recommended that the Bidder attend the Pre-Bid Meeting, either personally or through a representative identifying themselves as such.

SITE TOUR: A site tour of the Project Area will be conducted immediately following pre-bid meeting on **June 26, 2025**, following the Pre-Bid Meeting referenced above at the Project site located at 1033 Springfield Avenue, Cranford, New Jersey 07016. Attendance at the site tour is also not mandatory. However, it is strongly recommended that the Bidder attend the site tour, either personally or through a representative identifying themselves as such.

If the Bidder has any questions or finds any perceived error or omission in the RFB or any conflict or discrepancy within the RFB, the Bidder shall submit a written Request for Information ("RFI") to the Authority for interpretation or clarification. The Bidder shall be responsible for delivery of all such RFIs to Dr. Bibi Taylor, Executive Director at btaylorUCIA@ucnj.org, Madelyn Pena at mpena@digrouparchitecture.com, and Troy Marzziotti at tmarzziotti@mastconstruction.com, not later than **August 5, 2025 at 4:00 p.m.** No oral interpretations and responses will be made. Responses to all RFI will be made by Addenda by no later than **August 8, 2025**.

The RFB constitutes an invitation to submit Bids to the Authority, and does not represent an offer, obligation or agreement on the part of the Authority. The Authority reserves the right to (i) reject any Bid in accordance with N.J.S.A. 40A:11-13.2 and any Bid that is deemed not responsible in accordance with law; and (ii) to waive minor immaterial informalities or technical errors in accordance with law. Bids must be prepared and submitted in the manner set forth in the RFB. The Authority also reserves the right to make modifications or additions to the RFB prior to the Bid submission date. To the extent the Authority, in its sole discretion, determines to amend, modify, supplement, revoke or alter any other material term or condition of the RFB, including, without limitation, the procurement process or the criteria for award, which rights are hereby expressly reserved to the Authority, the Authority will communicate any such change in an Addenda in accordance with N.J.S.A. 40A:11-23c.2, no later than seven (7) days, Saturdays, Sundays, or holidays excepted, prior to the date for acceptance of Bids, to any person who has submitted a Bid or who has received a bid package by certified facsimile transmission.

This Project is being funded Chapter 12 Bonds - self-refurbishing capital funding for Community Colleges, where the County issues bonds for the construction and the State shares the debt service equally with the County and from County College Reserves

By submitting a Bid, each Bidder, without any other act, acknowledges and agrees to comply with each of the terms and conditions of the RFB. Bidders are required to comply with the requirements of N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27 et seq. As a result of the partial Federal funding involved with the Project, Bidders and their subcontractors must also be able to provide a Unique Entity ID (UEI) from Sam.Gov (the System of Award Management) and must maintain an active SAM registration through Final Completion of the Project. Please consult SAM.gov for more information or if you have questions about obtaining an UEI.

The Authority will award a contract or reject all Bids within sixty (60) days after receipt of the Bids unless otherwise agreed by the parties in accordance with applicable law.

Any inconsistency between this notice and the RFB shall be governed by the terms of the RFB.

By Order of the Commissioners of the Union County Improvement Authority

SECTION 1
INTRODUCTION AND GENERAL INFORMATION

I. INTRODUCTION

Union College is proposing to expand their outdated Physical Education Center to fulfill its continuing need to provide a collegiate level competitive sport and recreational venue with allied physical educational and support spaces on their Cranford, NJ main campus. The project consists of an addition and renovation at the southwest end of their main campus building. The footprint of the addition is 33,150 sf, consisting of a new gymnasium to replace the undersized, high school level gym currently being utilized along with a weight room, visiting team locker room, therapy rooms and the athletic success educational program classroom. The second floor of the addition is 1,900 sf, consisting only of an egress corridor from the existing second floor building, stair and electric room. The remainder of the athletic spaces that exists in the current building will be renovated to provide locker rooms for men and women, adequate office space for program management and sports officials, e-sports gaming competition area; wrestling room; sports education training rooms and adequate storage and support areas.

The Project schedule anticipates the commencement of construction of the Project (Notice to Proceed) on or about **September 29, 2025** in order to achieve substantial completion, with a Temporary Certificate of Occupancy at a minimum, and ready for occupancy by the County by no later than. August 5, 2027.

This Project is being funded by Chapter 12 Bonds - self-refurbishing capital funding for Community Colleges, where the County issues bonds for the construction and the State shares the debt service equally with the County and from County College Reserves

The Project is being procured as a lump sum bid proposal and the Contract will be subject to New Jersey's Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq. The Project is also subject to a Project Labor Agreement.

II. DEFINITIONS

Whenever the following words and terms appear in this RFB, which includes the Contract and Specifications and Scope of Work documents, they shall have the meanings set forth below, unless the context clearly dictates otherwise. Bidders are advised that additional words and terms may be defined in the body of the text of the Contract and Specifications and Scope of Work documents:

Applicable Laws and Regulations means any applicable permits, licenses or approvals and any statute, law, constitution, charter, ordinance, resolution, judgment, rule, order, decree, regulation standard or similarly binding authority which shall be enacted, adopted,

promulgated, issued or enforced by the State of New Jersey or Federal government or County of Union, relating to the work to be performed by the Authority under the RFB.

Authority means the Union County Improvement Authority or the Authorized Representative of the Authority.

Authorized Representative of the Authority means any member, committee, officer, or representative of the Authority duly authorized to execute the Contract on behalf of the Authority.

Authorized Representative of the Bidder means any member, committee, officer, or representative of the Bidder duly authorized to execute the Contract on behalf of the Bidder. If the Bid is made by an individual, then the Authorized Representative shall be the individual; if made by a firm or partnership, the Authorized Representative shall be all of the general partners; if made by a corporation, the Authorized Representative shall be an official authorized by the corporation as evidenced by Corporate Resolution; if made by a joint venture, the Authorized Representative of the joint venture shall be the Authorized Representative of each member of the joint venture as indicated above for each entity.

Bid means the Bid proposal submitted to the Authority by the Bidder to enter into the Contract for the performance of the Work which satisfies all of the material requirements of the RFB.

Bidder means the person, firm, corporation or entity that submits a Bid to the Authority.

Contract means the Contract to be executed between the Successful Bidder and the Authority. The Contract includes as a part thereof, the RFB, and all Addenda, if any issued to the RFB, the Bid of the Successful Bidder, including all documents submitted to the Authority therewith, or relating thereto, all documents submitted to the Authority by the Successful Bidder in connection with or subsequent to the award of the Contract to the Successful Bidder or the execution thereof, all change orders or other modifications of the Contract entered into by the Successful Bidder and the Authority, the award of the Contract or the Work or performance thereof, and all directions or instructions issued by or on behalf of the Authority to the Successful Bidder concerning the Contract and/or the performance of the Work.

Contractor means the Successful Bidder who enters into the Contract with the Authority.

Contract Price means the amount of the Bid Proposal set forth in Exhibit C-1 and as modified by any change orders as may be executed by the Parties.

Contract Term means the term of the Contract, which commences on the date of the execution of the Contract and continues through Final Completion of the Project as set forth in the Project Specifications in Appendix D hereto.

Days means calendar days unless otherwise noted.

Notice means a written notice.

Notice to Proceed means the notification letter from the Authority to the Successful Bidder stating the date the Successful Bidder can begin the Work subject to the conditions of the Contract. The performance time of the Contract starts from the commencement date identified in the Notice to Proceed.

Parties means collectively, the Authority and the Successful Bidder.

Project means the construction of A renovation / addition / expansion of the Union College of Union County Physical Education Center

Project Specifications means all plans and drawings relating to the Work

Subcontractor means a person, firm, corporation or entity supplying labor materials and/or other services regarding the Work to be performed under the Contract under separate contract or agreement with the Successful Bidder.

Successful Bidder means the Bidder whose Bid has been deemed the lowest responsive and responsible Bid and is referred to as the Contractor under the Contract.

Work means the work required to be performed or provided by the Successful Bidder, all drawings relating to the Work, and all activities and effort necessary to deliver same to the Authority in accordance with the Contract.

III. BID SUBMISSION DATE AND DELIVERY REQUIREMENTS

Bidders are required to submit Bids in the form set forth in the RFB. Failure to comply with the bidding requirements may constitute a material deficiency which may be cause for rejection of the Bid.

Bids must be received by the Authority by no later than **11:00 a.m. on August 19, 2025**, at which time they will be publicly opened and read aloud. Bids shall be submitted in a securely SEALED envelope and addressed to: Dr. Bibi Taylor, Executive Director, 10 Elizabethtown Plaza, 5th Floor, Elizabeth, New Jersey 07207. Unsealed, faxed or e-mailed Bids will not be accepted. The Authority shall not be responsible for, nor be required to, grant relief from non-delivery of Bids forwarded by mail or third-party messenger/delivery services.

The Authority reserves the right to postpone the date for receipt and opening of Bids and will give written notice of any such postponement to each prospective Bidder as required by law.

IV. COST OF BID PREPARATION

Each Bid and all information required to be submitted pursuant to this RFB, shall be

prepared at the sole cost and expense of the Bidder. There shall be no claims whatsoever against the Authority, its staff or its professional consultants, including, but not limited to, engineers, attorneys, planners, architects, and surveyors, for reimbursement for the payment of any costs or expenses incurred by the Bidder in the preparation of the Bid or other information related in any way to this RFB.

V. QUESTIONS (RFIs), ADDENDA AND AMENDMENTS

Bidders are expected to thoroughly examine the RFB and all related Bid documents with care and observe all their requirements. If the Bidder has any questions or finds any perceived error or omission in the RFB or any conflict or discrepancy within the RFB, the Bidder shall submit a written RFI to the Authority for interpretation or clarification. Exhibit G-5 should be used by the Bidder for the submission of all RFI. The Bidder shall be responsible for delivery of all such RFIs directly to Dr. Bibi Taylor, Executive Director at btaylorUCIA@ucnj.org, Troy Marzziotti at tmarzziotti@mastconstruction.com, Madelyn Pena at mpena@digrouparchitecture.com and Louis N. Rainone, Esq., LRainone@njrcmlaw.com. by no later than **August 5, 2025 at 4:00 p.m.** No oral interpretations and responses will be made.

The Authority will not be responsible for any oral interpretation of the RFB. The responses to the RFI shall be in the form of an Addenda. Addenda will be issued by the Authority to each recipient of this RFB no less than seven (7) business days prior to the Bid submission date and will constitute a part of the RFB. All responses to the RFB must be prepared with full consideration of the Addenda issued by the Authority prior to the Bid submission date. Bidders shall be solely responsible for making certain that they have responded accordingly. Bidders shall complete and submit the Acknowledgment of Addenda Form provided in Exhibit C-4, as part of the Bid submission.

In the event a Bidder fails to notify the Authority of any ambiguities, errors or omissions, the Bidder shall be bound by the requirements of the RFB and the Bidder's submitted Bid.

The Bidder understands and agrees that its Bid is submitted on the basis of the RFB prepared by the Authority. The Bidder accepts the obligation to become familiar with the RFB. At the time of the opening of the Bids, each Bidder will be presumed to have read and to be thoroughly familiar with the RFB (including all Addenda thereto, if any) and to be fully informed and satisfied as to the conditions existing, the character and requirements of the Project, and the difficulties attendant to the Work. The failure or omission of any Bidder to examine any portion of the RFB or any form, exhibit, instrument, or documents made a part thereof, shall in no way relieve any Bidder from any obligation under the Contract. Further, each Bidder must inform himself/herself fully of the conditions relating to the production and delivery of the Work and the employment of labor therefor. Failure to do so will not relieve a Successful Bidder of the obligation to furnish all equipment, material, supplies and labor necessary to carry out the provisions of the Contract.

Any Bidder who wishes to challenge any part of the RFB and its exhibits, forms, appendices and attachments, shall file such challenge in writing with the Authority, to the

attention of: Dr. Bibi Taylor, Executive Director at btaylorUCIA@ucnj.org, with a copy to the Authority's Special Counsel, Louis N. Rainone, Esq., at LRainone@njrcmlaw.com;, no less than three (3) business days prior to the Bid submission date . Challenges filed after that time shall be considered void and having no impact on the Authority or the award of the Contract pursuant to N.J.S.A. 40A:11-13.

VI. WITHDRAWAL OF BID

N.J.S.A. 40A:11-23.3 authorizes a Bidder to request withdrawal of a public works Bid due to a mistake on the part of the Bidder. A mistake is defined by N.J.S.A. 40A:11-2(42) as a clerical error that is an unintentional and substantial computational error or an unintentional omission of a substantial quantity of labor, material, or both, from the final Bid computation.

A Bidder claiming a mistake under N.J.S.A. 40A:11-23.3 must submit a request for withdrawal, in writing, by certified or registered mail to the Authority. A Bid may be withdrawn upon receipt by the Authority of a written, notarized request for withdrawal from the Authorized Representative of the Bidder due to a mistake, as defined by the law, within five (5) business days after the receipt and opening of the Bids. Since the Bid withdrawal request shall be effective as of the postmark of the certified or registered mailing, the Authority may contact all Bidders, after Bids are opened, to ascertain if any Bidders wish to, or already have exercised a request to withdraw their Bid pursuant to N.J.S.A. 40A:11-23.3.

A Bidder's request to withdraw the Bid shall include evidence, including any pertinent documents, demonstrating that a mistake was made and was of so great a consequence that:

(1) the enforcement of the contract, if actually made, would be unconscionable;

(2) the mistake related to a material feature of the Bid;

(3) the mistake occurred notwithstanding the fact that the Bidder exercised reasonable care in preparation of the Bid; and

(4) the Bidder making the mistake is able to get relief by way of withdrawing the Bid without serious prejudice to the Authority, except for the loss of the bargain to the Authority.

Such documents and relevant written information shall be reviewed and evaluated by the Authority's designated staff pursuant to the statutory criteria of N.J.S.A. 40A:11-23.3.

The Authority will not consider any written request for a Bid withdrawal for a mistake, as defined by N.J.S.A. 40A:11-2(42), by a Bidder in the preparation of a Bid proposal unless the postmark of the certified or registered mailing is within the five (5) business days following the opening of Bids.

If a Bidder withdraws a Bid, the Bidder shall be disqualified from future Bidding on the

same project, including whenever all Bids are rejected pursuant to N.J.S.A. 40A:11-13.2.

VII. CERTIFICATION AND OWNERSHIP OF DOCUMENTS

All documents resulting from the Work provided by the Bidder pursuant to this RFB, shall be the sole property of the Authority. No documents shall be released to other parties without the prior written consent of the Authority.

VIII. DISCLOSURE OF INFORMATION IN BIDS

If the Bidder chooses to include material of a proprietary nature in its Bid, the Authority and County will attempt to keep such material confidential to the extent permitted by applicable law.

The Bidder must specifically identify the section of its Bid that contains such information by properly marking the applicable pages. Preferably, any sections which contain material of a proprietary nature shall be severable or removable from the Bids to assist the Authority and County in protecting this information. The Bidder shall also include the following notice in the introduction of the Bid, and shall prominently display on each page containing claimed proprietary information the words, "Proprietary Information":

> "The data on pages [ ] labeled "Proprietary Information", contain information that is a trade secret and/or which, if disclosed, would cause substantial injury to (Bidder's) competitive position. (Bidder) requests that such data be used only for the evaluation of its Bid and understands that disclosure will be limited only to the extent that the Authority and County determines it proper or to the extent that the Authority and County deems disclosure necessary according to law. If a Contract is awarded to (Bidder), the Authority and County will have the right to use or disclose the data as provided in the Contract executed with the (Bidder)."

The Authority and County will use best efforts to prevent the unauthorized disclosure of this information in applying the proprietary standard to marked data. However, the Authority and County do not assume liability for any loss, damage, or injury that may result from any disclosure or use of marked data or any disclosure of this or other information during the review of the Bids.

Notwithstanding the above, Bid forms (including cost information) will not, under any circumstances, be considered proprietary or confidential information. However, prior to the execution of a Contract, such information will be subject to the non-disclosure requirement.

IX. PRE-BID MEETING

A Pre-Bid Meeting will be held on **June 26, 2025, at 10:00 a.m.** The Pre-Bid Meeting will be held at the College located at 1033 Springfield Ave, Cranford, NJ in room N-4 in the Student Development Building. Bidders are directed to park in Lot #1. Attendance at the

Pre-Bid Meeting is not mandatory. However, it is strongly recommended that the Bidder either personally or through a representative identifying themselves as such, attend the Pre-Bid meeting. Failure to attend the Pre-Bid Meeting does not relieve the Bidder of any obligations or requirements. No questions will be answered or entertained at the Pre-Bid meeting and all questions must be submitted pursuant to Section V and will be responded to via written Addenda.

X. PRE-BID SITE TOUR

A site tour will occur at the Project Site at June 26, 2025, immediately following the Pre-Bid Meeting. The site tour will take place as the Project site located at 1033 Springfield Avenue, Cranford, New Jersey 07016. The Authority will schedule an additional site tour, if requested and if so, the Authority will provide Bidders with information on the time and date for such additional site tour. Attendance at the site tour is not mandatory. However, it is strongly recommended that the Bidder either personally or through a representative identifying themselves as such, attend the site tour.

XI. PROCUREMENT SCHEDULE – KEY DATES

RFB Issued	June 19, 2025
Pre-Bid Meeting Site Visit	June 26, 2025 @ 10:00 a.m. June 26, 2025
Deadline to Submit RFIs	August 5, 2025 @ 4:00 p.m.
Authority Response to RFIs	August 8, 2025
Bid Submission Due Date	August 19, 2025 @ 11:00 a.m.
Anticipated Notice to Proceed Date	September 29, 2025
Anticipated Substantial Completion Date	August 5, 2027, or 675 Days from the Notice to Proceed, whichever later occurs

XII. RESERVATION OF RIGHTS AND OPTIONS BY AUTHORITY WITH RESPECT TO THE RFB

By responding to the RFB, Bidders acknowledge and agree that the Authority, in its sole discretion, reserves the following rights and options regarding any and all Bids:

(a) To abandon the RFB process, including the right to decline to award the Contract in accordance with law.

(b) To waive any minor informalities or non-material exceptions with the provisions of this RFB in accordance with law.

(c) To reject any or all Bids in accordance with law.

(d) To reject incomplete or non-responsive Bids, or Bids not signed by an authorized representative of the Bidder.

(e) To change or alter the terms and conditions of this RFB so long as copies of such changes are sent to all the persons/entities who have received a copy of the RFB via Addenda issued in accordance with applicable law.

(f) To undertake all steps necessary, in accordance with applicable law, to obtain or clarify information as requested or provided by any Bidder.

(g) To make investigations deemed necessary to determine the responsibility and qualifications of Bidder and the ability of Bidder to perform the Work (defined herein) in accordance with law.

XIII. CONDITIONS OF AUTHORITY WITH RESPECT TO THE RFB

By responding to the RFB, Bidders acknowledge and consent to the following conditions relative to the submission, review and consideration of its Bid:

(a) The issuance of the RFB is not intended to, and shall not be construed to, commit the County or Authority to execute a contract with Bidder.

(b) Neither the County or Authority, nor their agents, staff, or consultants will be liable for any claims for damages resulting from the solicitation or receipt of Bids, nor will there be any reimbursement to Bidder for the cost of preparing the Bid or for participating in the Bid process.

(c) Failure of any Bidder to submit a Bid that completely addresses the requirements of this RFB, at the times and in the manner specified in this RFB, may result in the rejection of the Bid in accordance with law.

(d) All activities related to the provision of the services required pursuant to this RFB as contained herein, shall be subject to compliance with all applicable Federal, State and local laws, regulations and requirements.

(e) Any and all Bids must be received by the Due Date. Any Bid not received by that time will not be considered unless the Authority determines otherwise.

SECTION 2
GENERAL BID SUBMISSION REQUIREMENTS

Bidders must submit the documents and information set forth in this Section 2 and in Section 3 herein, as part of the Bid submission to demonstrate that the Bidder meets the requirements of the RFB. Failure to comply with the Bid requirements may constitute a material deficiency which may be cause for rejection of the Bid. The Bidder shall not reassemble or rearrange Exhibits or Exhibit pages but shall submit the required documents with all pages correctly assembled and no double-sided printing, in the order set forth by the Authority in the RFB.

I. BID DOCUMENT SUBMISSION CHECKLIST

Bidders must initial and sign the Bid Document Submission Checklist provided in Exhibit B-1 and include the completed form as part of its Bid submission.

II. TRUTH IN CONTRACTING/PENALTIES FOR FALSIFICATION

The following statutes that represent "Truth in Contracting" laws apply to this RFB and the Contract:

- N.J.S.A. 2C:21-34 governs false claims and representations by Bidders. It is a serious crime for the Bidder to knowingly submit a false claim and/or knowingly make material misrepresentation.
- N.J.S.A. 2C:27-11 provides that a Bidder commits a crime if said person, directly or indirectly, confers or agrees to confer any benefit not allowed by law to a public servant.
- Bidders should consult the statutes or legal counsel for further information.

Each Bidder shall certify its knowledge and understanding of the Truth in Contracting laws by completing Exhibit C-5 and including same as part of its Bid submission.

The following statute that represents "Penalties for Falsification" apply to this RFB and the Contract: N.J.S.A. 40A:11-33; 34:

Forfeiture of deposit in certain cases

A deposit made by any person who makes or causes to be made a false, deceptive or fraudulent statement or answers in response to a questionnaire or in the course of a hearing hereunder may be cause to be forfeited, as liquidated damages by and to the Authority.

Penalties for false statements

Any person who makes or causes to be made, a false, deceptive or fraudulent statement in the statement or answers in response to the questionnaire, or in the course of any hearing hereunder, shall be guilty of a misdemeanor, and upon conviction shall be punishable by a fine of not less than $100.00 nor more than $1,000.00, and shall be permanently

disqualified from bidding on all public work or contracts of the Authority which submitted the questionnaire; or, in the case of an individual or an officer or employee charged with the duty of responding to the questionnaire for a person, firm, copartnership, association or corporation, by such fine or by imprisonment, not exceeding 6 months, or both.

III. BID SECURITY, BONDING REQUIREMENTS, INDEMNIFICATION, INSURANCE AND WARRANTIES

3.1 Bid Security/Consent of Surety

3.1.1 - Amount and Form

Each Bid shall be accompanied by Bid Security in the amount of five percent (5%) of the Total Lump Sum Bid Proposal. The Bid Security shall be a certified, cashier's or treasurer's check or money order, or a Bid Bond substantially in the form provided for in this RFB.

3.1.1.1 - Any certified, cashier's or treasurer's check or money order shall be made payable to the order of the Authority and shall specify the title of the Contract as set forth in Section 1, Introduction, of this RFB.

3.1.1.2 - The Bid Bond shall be in substantially the same form and content as provided in Exhibit F-1 hereto, issued by a duly authorized Surety Company authorized to conduct business in the State of New Jersey by the New Jersey Department of Banking and Insurance, satisfying the standards set forth in N.J.S.A. 2A:44-143 and 2A:44-144, and listed by the United States Treasury Department in its latest Circular 570 list of qualified Surety Companies, and acceptable to the Authority. No Bond of an otherwise acceptable Surety will be accepted if the required Bonds exceed the limit for which the U.S. Treasury has qualified the Surety for any one Bond.

3.1.1.3 - In addition to Bid Security, and regardless of the chosen form of Bid Security, each Bid shall be accompanied by a Consent of Surety as to the Performance and Payment Bond, , and a Consent of Surety as to the General Maintenance Bond, all duly executed by a Surety satisfying the standards set forth above. Each Consent of Surety shall be in substantially the same form and content provided in Exhibit F-2, and Exhibit F-3, respectively, attached hereto, and shall provide that, in the event the Bidder is awarded the Contract, the Surety shall issue the applicable Bonds required by the RFB.

3.1.2 - Signatories

The Bid Bond and Consent of Surety shall be duly executed by the Bidder as Principal and the Surety Company's Attorney-in-Fact and witnessed and attested to with their certified and effectively dated Power of Attorney attached.

3.1.3 - Return of Bid Security

All Bid Security, except the security of the apparent lowest responsible, responsive Bidder, shall be returned unless otherwise requested by the Bidder within ten (10) days after the opening of the Bids, Sundays and Holidays excepted as set forth in N.J.S.A. 40A:11-24. The Bid Security held by the Authority from the Successful Bidder will be returned upon receipt of the following:

(a) Proper Performance and Payment Bond and any other required Bond pursuant to Section 3.2 below;

(b) Documentation of required insurance pursuant to Section 3.3 below; and

(c) Properly executed documents constituting the Contract.

3.1.4 - Forfeiture of Bid Security

Bid Security shall be forfeited in the event the Successful Bidder fails to execute and deliver the Contract or fails to deliver the required Bonds, Insurance and other required documents within the time set forth herein.

3.2 Bonds

Performance and Payment Bond

3.2.1 - Amount and Form

The Successful Bidder (a) shall furnish a Performance and Payment Bond issued by a Surety Company authorized to conduct business in the State of New Jersey by the New Jersey Department of Banking and Insurance, satisfying the standards set forth in N.J.S.A. 2A:44-143 and 2A:44-144, listed by the New Jersey Department of Banking and Insurance and by the U.S. Treasury Department in its latest Circular 570 list of qualified Surety Companies, and acceptable to the Authority for the full term and amount of the Bid, as accepted by the Authority; and (b) shall pay all premiums due thereon during the term of the Contract. The Performance and Payment Bond shall be in the amount of the Total Lump Sum Bid Proposal of the Successful Bidder and be conditioned upon the faithful performance of the Contract. No Bond of an otherwise acceptable Surety will be accepted if the required Bond exceeds the limit for which the U.S. Treasury Department has qualified the Surety for any one Bond. The Performance and Payment Bond shall be accompanied by the Surety Disclosure Statement and Certification. In the event the Surety is removed from said U.S. Treasury Department list of qualified surety companies or the list of surety companies authorized to do business in the State of New Jersey by the New Jersey Department of Insurance, the Contractor shall forthwith furnish a replacement Bond which satisfy these requirements.

3.2.2 - Signatories

The Attorney-in-Fact of the Surety must sign the Performance and Payment Bond and the Bond must be accompanied by a certified and effectively dated copy of the Power of Attorney for the Attorney-in-Fact.

3.2.3 - Forfeiture of Performance and Payment Bond

Failure to maintain compliance with the Project Specifications set forth in Appendix D, or to complete any of the Work or services set forth herein, or to comply with dates set forth herein, or to furnish any such Bond as may be required shall subject the Contractor to forfeiture of the Performance and Payment Bond and other damages as permitted by law and the Contract.

Maintenance Bond

3.2.4 - Amount and Form

For a period of two (2) years running from the date of authorization for Final Payment by the Board of Commissioners of the Authority at the Regular Authority Board Meeting, the Contractor shall provide all required repairs and replacements. As security for performance by the Contractor of this obligation during the guarantee period, the Contractor shall provide a Maintenance Bond in the amount of 100% of the sum of the total price set forth in Exhibit C-1, plus the value of any change orders as may be executed during the Term of the Contract (Final Contract Price). Any change in the Specifications shall in no way invalidate said Bond. In the event the Surety is removed from said U.S. Treasury Department list of qualified surety companies or the list of surety companies authorized to do business in the State of New Jersey by the New Jersey Department of Insurance, the Contractor shall forthwith furnish a replacement Maintenance Bond which satisfies these requirements.

3.2.5 - Signatories

The Authorized Representative for the Contractor and the Attorney-in-Fact for the Contractor's Surety must sign said Maintenance Bond and must file with said Bond a certified and effectively dated copy of the Power of Attorney.

3.2.6 - Submittal Time

The Contractor shall submit said Maintenance Bond at the time set forth in the Contract Documents.

3.2.7 - Forfeiture of Maintenance Bond in Whole or in Part

If during the term of the Maintenance Bond, the Work, equipment, parts, and/or materials supplied and/or furnished under the terms of this Contract fail to maintain operational and/or performance standards as detailed in the Specifications and Contract, where the Authority has operated, maintained, and/or utilized said Work, equipment and/or materials in conformance with the established applicable operation and maintenance requirements,

the Authority may, at its discretion place a claim against the Maintenance Bond in the amount necessary to effect repair and/or replacement of the Work, materials, parts and/or equipment at issue up to the full amount of said Maintenance Bond.

3.3 Indemnification and Insurance Requirements

3.3.1 - Indemnification

The Successful Bidder shall indemnify, hold harmless and defend the Authority and the Authority's officers and employees, from and against (a) any claim, demand, action or cause of action asserted by any of the Successful Bidder's officers, employees, agents or representatives, or any of Successful Bidder's Subcontractors, materialmen or suppliers, their officers, employees, agents or representatives or statutory beneficiaries by reason of any personal injury, death or property damage resulting from any occurrence on the Authority's premises or in the performance of the Work or any portion thereof, and (b) any and all losses, damages, claims, liabilities and causes of action of every kind and nature resulting from or arising out of any action or inaction of the Successful Bidder, its employees, agents, representatives, Subcontractors, or any of their materialmen or suppliers in the performance of the Work or any portion thereof. No insurance required herein to be maintained by the Successful Bidder shall in any way relieve or diminish the Successful Bidder's responsibilities, obligations, and/or liabilities under the Contract.

3.3.2 - Insurance Requirements

The Successful Bidder shall carry and maintain at all times while the Contract is in full force and effect, the following insurance coverage with an insurance company or companies acceptable to the Authority, with limits not less than those shown below. A Certificate of Insurance shall be filed with the Authority prior to commencement of the work.

Any combination of primary and umbrella/excess policies may be used to satisfy the limits. All the provisions below shall also apply to the umbrella/excess policies for such coverages listed below.

a) Commercial General Liability (CGL): Coverage for all operations including, but not limited to, contractual, products and completed operations, and personal injury with limits no less than $10,000,000 per occurrence/$10,000,000 aggregate. The Authority its officers, officials, employees, agents and volunteers shall be included as an additional insured.

b) Automobile Liability: Coverage for all owned, non-owned and hired vehicles with limits not less than $5,000,000 per occurrence, combined single limits (CSL) or its equivalent.

c) Workers Compensation: As required by the State of New Jersey and Employers Liability with limits not less than $1,000,000 per accident for bodily injury or disease.

d) Professional Liability (if design/build): Coverage with limits not less than $10,000,000 per occurrence or claim, $10,000,000 aggregate.

e) Cyber Liability: $5,000,000 per claim/$5,000,000 aggregate.

F) Contractor's Pollution Legal Liability and/or Asbestos Legal Liability and/or Errors & Omissions (if project involves environmental hazards): Coverage with limits no less than $10,000,000 per occurrence or claim/$10,000,000 aggregate.

Builders Risk: The Authority is responsible to provide and maintain Builders Risk Insurance.

Special Risks or Circumstances: The Authority reserves the right to modify these requirements, including limits, based on the nature of the risk, prior experience, insurer, coverage, or other special circumstances.

3.3.3 - Self-Insured Retentions

Self-insured retentions must be declared to and approved by the Authority. At the option of the Authority, either: the Contractor shall cause the insurer to reduce or eliminate such self-insured retentions as respects the Authority, its officers, officials, employees, and volunteers; or the Contractor shall provide a financial guarantee satisfactory to the Authority guaranteeing payment of losses and related investigations, claim administration, and defense expenses. The policy language shall provide, or be endorsed to provide, that the self-insured retention may be satisfied by either the named insured or the Authority.

3.3.4 - Other Insurance Provisions

The insurance policies are to contain, or be endorsed to contain, the following provisions:

3.3.4.1. The Authority, its officers, officials, employees, and volunteers are to be covered as additional insureds on the CGL policy with respect to liability arising out of work or operations performed by or on behalf of the Contractor including materials, parts, or equipment furnished in connection with such work or operations and automobiles owned, leased, hired, or borrowed by or on behalf of the Contractor. General liability coverage can be provided in the form of an endorsement to the Contractor's insurance.

3.3.4.2. For any claims related to this project, the Contractor's insurance coverage shall be primary insurance coverage as to the Authority, its officers, officials, employees, and volunteers. Any insurance or self-insurance maintained by the Authority, its officers, officials, employees, or volunteers shall be excess of the Contractor's insurance and shall not contribute with it.

3.3.4.3. Each insurance policy required by this clause shall provide that coverage shall not be canceled, except with notice to the Authority.

3.3.5 - Claims Made Policies (If at all possible, avoid and require occurrence type CGL policies)

If any coverage required is written on a claims-made coverage form:

3.3.5.1. The retroactive date must be shown, and this date must be before the execution date of the Contract or the beginning of Contract Work.

3.3.5.2. Insurance must be maintained, and evidence of insurance must be provided for at least five (5) years after completion of Contract Work.

3.3.3.3. If coverage is cancelled or non-renewed, and not replaced with another claims-made policy form with a retroactive date prior to the Contract effective, or start of work date, the Contractor must purchase extended reporting period coverage for a minimum of five (5) years after completion of Contract Work.

3.3.5.4. If the services involve lead-based paint or asbestos identification/remediation, the Contractors Pollution Liability policy shall not contain lead-based paint or asbestos exclusions. If the services involve mold identification/remediation, the Contractor's Pollution Liability policy shall not contain a mold exclusion, and the definition of Pollution shall include microbial matter, including mold.

3.3.6 - Acceptability of Insurers

Insurance is to be placed with insurers authorized to conduct business in the State of New Jersey with a current A.M. Best rating of no less than A- VII, unless otherwise acceptable to the Authority.

3.3.7 - Waiver of Subrogation

The Contractor hereby agrees to waive rights of subrogation which any insurer of the Contractor may acquire from the Contractor by virtue of the payment of any loss. The Contractor agrees to obtain any endorsement that may be necessary to affect this waiver of subrogation. The Workers' Compensation policy shall be endorsed with a waiver of subrogation in favor of the Authority for all work performed by the Contractor, its employees, agents and Subcontractors.

3.3.8 - Verification of Coverage

The Contractor shall furnish the Authority with original Certificates of Insurance including all required amendatory endorsements (or copies of the applicable policy language effecting coverage required by this clause) and a copy of the Declarations and Endorsement Page of the CGL policy listing all policy endorsements to the Authority before work begins. However, failure to obtain the required documents prior to the work beginning shall not waive the Contractor's obligation to provide them. The Authority reserves the right to

require complete, certified copies of all required insurance policies, including endorsements, required by these specifications, at any time.

3.3.9 - Subcontractors

The Contractor shall require and verify that all Subcontractors maintain insurance meeting all requirements stated herein, and the Contractor shall ensure that the Authority is an additional insured on insurance required by Subcontractors.

3.4 Certificates of Insurance

3.4.1 - Submittal Date

The Successful Bidder shall furnish Certificate(s) of Insurance evidencing the above insurance coverage, and the Authority and Engineer shall be listed as additional insured on the policy for "owners, lessees, or Contractors." The Certificate(s) of Insurance shall state that the Authority, The Construction Manager, The Architect / and the Engineer "is an additional insured with respect to liability arising out of the Contractor's operations performed for the Authority," or equivalent language. The Certificate(s) of Insurance shall be submitted with the fully executed counterparts of the Contract.

3.4.2 - Notice of Termination or Change

Said Certificate(s) of Insurance shall be endorsed to indicate that the insurer shall not terminate the coverages listed therein unless it first provides the Authority not less than thirty (30) days' notice of termination of coverage or substantial changes thereof.

3.4.3 - Additional Insured

The following shall be listed as additional insureds on all certificates of insurance furnished pursuant to this contract:

(a) Union County Improvement Authority

(b) County of Union

(c) Construction Manager / Owner's Representative

(d) Construction/Consulting Engineers

(e) Resident and/or QA/QC Engineers to be named by the Authority

(f) NJDEP/Regulatory and Funding Agencies as applicable

(g) The successors in interest of any or all of the above

3.4.4 - Commencement of Work

The Contractor shall not commence any Work under this Contract until all insurance required under these Specifications has been obtained and approved by the Authority, nor

shall the Contractor allow any Subcontractor to commence Work on a subcontract until all similar insurance required of the Subcontractor has been so obtained and approved.

3.5 Contractor's Guarantee for Acceptance of Defective Work

The Authority may require the Contractor to furnish, at the Contractor's expense, a special Performance Guarantee or other surety prior to acceptance of defective work or materials.

3.6 Contractor's Warranty of Title

The Contractor warrants and guarantees that title to all work, materials and equipment covered by any payment request, will pass to the Authority at the time of payment free and clear of all liens, claims, security interests and encumbrances, and the Authority may require the Contractor to furnish said title(s) prior to payment for said work, materials or equipment.

IV. BID PROPOSAL

Each Bid shall be submitted in writing and signed by the Bidder's Authorized Representative in the spaces provided on the Price Proposal Form set forth in Exhibit C-1 hereto, and shall specify the price for the Work, both in words and figures (as indicated on said Proposal Form) for which the Bidder will fulfill all the terms and conditions hereof. Partial Bids shall not be accepted. Bids shall include all costs of furnishing, delivering the work as specified in this RFB.

If the amount shown in words and its equivalent in figures do not agree, the written words shall be binding. Ditto marks are not considered writing or printing and shall not be used.

The Authority is exempt from any local, state or federal sales, use or excise tax. The Authority will not pay for N.J. State Sales and Use Tax that are included in any invoices from the Successful Bidder or any of its Subcontractors. Any and all such taxes, to the degree they may be imposed (including by way of example and not limitation, taxes imposed in connection with the lease or rental of equipment used in connection with any Authority project) shall be the sole responsibility of the Contractor any of its Subcontractors as applicable.

The Bidder shall be responsible for obtaining and maintaining at their own cost and expense, any applicable and required permits, licenses and approvals from any government entity that has jurisdiction to require the same, that may be necessary to discharge the Bidder's obligations set forth in the Contract. All Bids submitted shall have included this cost.

V. SUBCONTRACTORS

The Bidder is specifically advised that the Contract may not be brokered and any person, firm or other party to whom the Bidder proposes to award any subcontract, must be a

responsible Subcontractor, holding applicable licenses, acceptable to the Authority. The Bidder shall list those Subcontractors specifically identified for disclosure in Exhibit C-2. The Authority has the right to recommend the debarment, suspension, or disqualification of any Subcontractor who fails to perform in accordance with the Contract to the State of New Jersey's Department of Community Affairs pursuant to N.J.A.C. 5:4-1.1 et seq., or such other agency as may be applicable.

The Bidder shall be required to furnish evidence of the qualifications of any and all listed Subcontractors proposed to be used in performance of Work under the terms of this Contract. Disclosure of said qualifications shall be included with the Bid submission and shall include, but shall not be limited to, evidence of all applicable licenses, including but not limited to electrical and plumbing licenses.

The Bidder is specifically advised that any subcontracted portion of the Contract, as may be acceptable to the Authority, shall be subject to the terms and conditions contained herein and as further addressed in this RFB.

In accordance with the requirements of N.J.S.A. 40A:11-16, if a Bidder sets forth more than one Subcontractor in Exhibit C-2 for any of the following trade categories below, the Bidder shall submit to the Authority, a certificate signed by the Bidder, listing each Subcontractor named in the Bid for that category:

i. The plumbing and gas fitting and all kindred work.

ii. Steam power plants, steam and hot water heating and ventilating apparatus and all kindred work.

iii. Electrical work.

iv. Structural steel and ornamental iron work.

The certificate shall set forth the scope of work, goods and services for which the Subcontractor has submitted a price quote and which the Bidder has agreed to award to each Subcontractor listed, should the Bidder be awarded the Contract. The certificate shall be attached by the Bidder to Exhibit C-2 and submitted to the Authority as part of the Bid submission. The certificate may take the form of a single certificate listing all Subcontractors or, alternatively, a separate certificate may be submitted for each Subcontractor. If a Bidder does not include a certificate or certificates to the Authority, the Authority shall award the Contract to the next lowest responsible Bidder.

The Authority may make such investigations, in accordance with applicable law, as it deems necessary or appropriate to determine the ability of the Bidder and/or any of the Bidder's proposed Subcontractors to perform the Work, and the Bidder shall furnish to the Authority all such information and data for this purpose as the Authority may request.

In the event the Bidder determines, during the course of the Work, that there is a need to engage the services of a Subcontractor that was not initially identified by the Bidder as part of the Bidder's Bid submission in Exhibit C-2, the Bidder must contact the Authority prior

to using the Subcontractor. The Authority will provide the Bidder with certain information forms that will need to be completed by the Bidder regarding the Subcontractor, and the Bidder must return the forms with the documentation requested in the forms, within seven (7) calendar days of receipt of the forms. The forms and documentation will be reviewed by the Authority. If the Subcontractor information is acceptable to the Authority, the Bidder will be advised of the Authority's approval of the Subcontractor. Upon receipt of such approval, the Bidder will then be able to proceed to use the Subcontractor. The Bidder cannot proceed to use the Subcontractor until the Subcontractor has been approved by the Authority.

The Successful Bidder shall be as fully responsible to the authority for the acts and omissions of his Subcontractors, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by the Successful Bidder.

The Successful Bidder shall cause appropriate provisions to be inserted in all Subcontracts relative to the Work to require compliance by each Subcontractor with the applicable provisions of the Contract for the Work required in the Contract.

Northing contained in the Contract shall create any contractual relation between any Subcontractor and the Authority.

VI. STATE PREVAILING WAGE

The Successful Bidder and the Bidders' Subcontractors shall be required to comply with the following applicable statutes.

a. NJ Prevailing Wage Act. To the extent that the Contract involves the construction, reconstruction, demolition, alteration, fabrication, or maintenance work, including painting or decorating of premises owned by the Authority, it is subject to the requirements of the New Jersey Prevailing Wage Act, N.J.S.A. 34: 11-56.25 et seq. In the event it is found that any worker employed by the Successful Bidder or any Subcontractor covered by the Contract has been paid a rate of wages less than the prevailing wage rate required to be paid by the Contract, the Authority, the lessee to whom the Authority is leasing a property or premises, or the lessor from whom the Authority is leasing or will be leasing a property or premises, may terminate the Successful Bidder's or Subcontractor's right to proceed with the Work, or such part of the Work as to which there has been a failure to pay required wages, and to prosecute the Work to completion or otherwise. The Successful Bidder and its Surety shall be liable to the Authority, any lessee to whom the Authority is leasing a property or premises or to any lessor from whom the Authority is leasing or will be leasing a property or premises, for any excess costs occasioned by the termination of their right to proceed with the work, or such part of the work as to which there has been a failure to pay required wages.

In accordance with N.J.S.A. 34:11-56.27a, if the Bid of the lowest responsible Bidder for the Contract is ten percent (10%) or more lower than the next lowest bid for the Contract, the lowest responsible Bidder will be required by the Authority to certify to the Authority, prior to the award of the Contract that prevailing wage rates required by the New Jersey Prevailing Wage Act shall be paid. If the Bidder does not provide the certification prior to award of the Contract, the Authority shall award the Contract to the next lowest responsible and responsive Bidder.

The State Prevailing Wage Rates for Union County can be found at https://lwdwebpt.dol.state.nj.us/archivewages/258092556-union-9-15-23.pdf.

VII. EQUIPMENT

The Bidder shall provide a list of all equipment to be used in fulfilling the terms of the Contract in the Certification of Equipment in Exhibit C-3 hereto.

VIII. LICENSING

When required by the nature of the Work set forth in the RFB, the Bidder shall provide evidence of all applicable licenses.

SECTION 3
STATUTORY AND OTHER BID SUBMISSION REQUIREMENTS

In addition to the Submission Requirements set forth above in Section 2 of this RFB, the following documents are to be submitted by the Bidder as part of the Bid submission.

MANDATORY EQUAL OPPORTUNITY LANGUAGE/ANTI-DISCRIMINATION
(N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27-1 et seq.; 41 C.F.R Section 60-1.4(b)

A Bidder may not be issued a Contract unless it complies with the affirmative action provisions of N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27-1 et seq. as administered by the Division of Purchase & Property Contract Compliance and Audit Unit ("Division"). Exhibit A of this RFB contains the current and complete mandatory language for construction bid specifications and contracts. This document is the mandatory language for construction bid specifications and contracts pursuant to N.J.A.C. 17:27-3.5, and the mandatory bid specification and contract language for employment goal compliance for construction contracts at N.J.A.C. 17:27-3.7. A complete review of both rule provisions by Bidders is recommended. The Bidder shall also be required to comply with the Mandatory Equal Employment Opportunity requirements of 41 C.F.R Section 60-1.4(b).

Bidders should submit with their Bid the Bidder's Certification of Equal Employment Opportunity forms in Exhibits A1 and A-2 hereto. The Contract with the Successful Bidder shall include this required language.

The Successful Bidder shall also complete and submit, as applicable, an Initial Project Workforce Report, Form AA-201 after notification of award but prior to execution of the Contract. Proper completion and submission of this Report shall constitute evidence of the Successful Bidder's compliance with the regulations. Failure to submit this form may result in the Contract being terminated. The Successful Bidder also agrees to submit a copy of the Monthly Project Workforce Report, Form AA-202 once a month thereafter for the duration of the contract to the Department of Labor and Workforce Development and to the Authority's Public Agency Compliance Officer after notification of award, but prior to signing the Contract.

Anti-Discrimination.

In accordance with N.J.S.A. 10:2-1, the Contractor agrees as follows that:

a. In the hiring of persons for the performance of Work under this Contract or any subcontract hereunder, or for the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under this Contract, no Contractor, nor any person acting on behalf of the Contractor or Subcontractor, shall, by reason of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex, discriminate against any person who is qualified and available to perform the work to which the employment relates;

b. No Contractor, Subcontractor nor any person on the Contractor's behalf shall, in any manner, discriminate against or intimidate any employee engaged in the

performance of Work under this Contract or any subcontract hereunder, or engaged in the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under such contract, on account of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex;

c. There may be deducted from the amount payable to the Contractor by the Authority, under this Contract, a penalty of $50.00 for each person for each calendar day during which such person is discriminated against or intimidated in violation of the provisions of the Contract; and

d. The Contract may be canceled or terminated by the Authority and all money due or to become due hereunder may be forfeited for any violation of this section of the Contract occurring after notice to the Contractor from the Authority of any prior violation of this section of the Contract.

Inclusion of Minority/Women Businesses in Project

The Authority strongly encourages Bidders and its Subcontractors to maximize the use of women and minorities as part of the workforce for the Project and to attempt in good faith to employ minority and female workers as contractors/subcontractors/businesses/ vendors/suppliers, consistent with the applicable county employment goals prescribed by N.J.A.C. 17:27-5.2, as amended and supplemented from time to time, or in accordance with a binding determination of the applicable county employment goals determined by the Division of Contract Compliance & Equal Employment Opportunity in Public Contracts (hereinafter, the "Division") pursuant to N.J.A.C. 17:27-5.2, as amended and supplemented from time to time. The applicable employment goals for Union County can be obtained from the New Jersey Department of Treasury Equal Employment Opportunity and Affirmative Action website at https://www.nj.gov/treasury/contract_compliance/.

II. AMERICANS WITH DISABILITIES ACT OF 1990

Discrimination on the basis of disability in contracting is prohibited. Bidders are required to read the Americans with Disabilities language and complete the certification that is included as Exhibit G-2 to this RFB. The provisions of Title II of the Act shall be made a part of the Contract. The Bidder is obligated to comply with the Act and to hold the Authority harmless.

III. NEW JERSEY BUSINESS REGISTRATION CERTIFICATE

In accordance with N.J.S.A. 52:32-44(b), a Bidder and its named Subcontractors must have a valid Business Registration Certificate ("BRC") issued by the Department of Treasury, Division of Revenue and Enterprise Services prior to award of a contract. While submission of the BRC is not statutorily required at the time of Bid submission, to facilitate the Bid evaluation and Contract award process, the Bidder is encouraged to submit a copy

of its valid BRC and those of all Subcontractors identified in Exhibit C-2, with its Bid. Failure to include these BRCs with the Bid submission will not result in rejection of the Bid, however, any required BRCs must be submitted to the Authority prior to award of a contract.

Any Bidder, inclusive of any Subcontractors identified in Exhibit C-2, who does not have a valid BRC as of the Bid Due Date or whose BRC was revoked prior to the Bid Due Date, should proceed immediately to register its business or seek reinstatement of a revoked BRC. The Bidder and its Subcontractors identified in Exhibit C-2, may register with the Division of Revenue and Enterprise Services, obtain a copy of an existing BRC or obtain information necessary to seek reinstatement of a revoked BRC online at http://www.state.nj.us/treasury/revenue/busregcert.shtml.

Bidders are cautioned that it may require a significant amount of time to secure an initial BRC or the reinstatement of a revoked BRC. The process can require actions by both the Division of Revenue and Enterprise Services and the Division of Taxation. For this reason, a Bidder's attention to this requirement prior to Bidding is highly recommended.

A Bidder receiving a Contract award as a result of this procurement and any Subcontractors identified in Exhibit C-2 by that Bidder will be required to maintain a valid business registration with the Division of Revenue and Enterprise Services for the duration of the executed Contract, inclusive of any Contract extensions.

For the term of the Contract, the Successful Bidder and each of its affiliates (N.J.S.A. 52:32-44(g)(3)) and each Subcontractor identified in Exhibit C-2 and each of its affiliates shall collect and remit to the Director, New Jersey Division of Taxation, the use tax due pursuant to the Sales and Use Tax Act (N.J.S.A. 54:32B-1 et seq.) on all sales of tangible personal property delivered into this State, regardless of whether the tangible personal property is intended for a contract with a Contracting Agency.

Pursuant to N.J.S.A. 54:49-4.1, a business organization that fails to provide a copy of a Business Registration as required by N.J.S.A. 52:32-44 et seq., or that provides false Business Registration information, shall be liable for a penalty of $25 for each day of violation, not to exceed $50,000, for each proof of Business Registration not properly provided.

IV. NEW JERSEY STATE DEBARRED, SUSPENDED & DISQUALIFIED BIDDER

The Bidder shall certify, on the form contained in Exhibit D-1 hereof, that the Bidder is not at the time of the submission of its Bid and has not been, at any time within three (3) years immediately preceding the Bid submission date, listed on the New Jersey State Treasurer's List of Debarred, Suspended, or Disqualified Bidders (the "Treasurer's List"). Exhibit D-1 shall be signed by the Authorized Representative of the Bidder and included in the Bid. The Bidder shall immediately notify the Authority whenever it appears that the Bidder has been placed on the Treasurer's List, and the Successful Bidder shall have the same obligation to notify the Authority throughout the term of the Contract. The Bidder

may be debarred, suspended or disqualified from contracting with the Authority if the Bidder commits any of the Acts listed in N.J.A.C. 5:4-1.2.

V. OWNERSHIP DISCLOSURE

No corporation, partnership, or limited liability company shall be awarded any contract nor shall any agreement be entered into for the performance of any work or the furnishing of any materials or supplies, the cost of which is to be paid with or out of any public funds, by the State, or any county, municipality or school district, or any subsidiary or agency of the State, or of any county, municipality or school district, or by any authority, board, or commission which exercises governmental functions, unless prior to the receipt of the Bid or accompanying the Bid, of said corporation, said partnership, or said limited liability company there is submitted a statement setting forth the names and addresses of all stockholders in the corporation who own 10 percent or more of its stock, of any class, or of all individual partners in the partnership who own a 10 percent or greater interest therein, or of all members in the limited liability company who own a 10 percent or greater interest therein, as the case may be. If one or more such stockholder or partner or member is itself a corporation or partnership or limited liability company, the stockholders holding 10 percent or more of that corporation's stock, or the individual partners owning 10 percent or greater interest in that partnership, or the members owning 10 percent or greater interest in that limited liability company, as the case may be, shall also be listed. The disclosure shall be continued until names and addresses of every noncorporate stockholder, and individual partner, and member, exceeding the 10 percent ownership criteria established in this act, has been listed.

To comply with this section, a Bidder with any direct or indirect parent entity which is publicly traded may submit the name and address of each publicly traded entity and the name and address of each person that holds a 10 percent or greater beneficial interest in the publicly traded entity as of the last annual filing with the federal Securities and Exchange Commission or the foreign equivalent, and, if there is any person that holds a 10 percent or greater beneficial interest, also shall submit links to the websites containing the last annual filings with the federal Securities and Exchange Commission or the foreign equivalent and the relevant page numbers of the filings that contain the information on each person that holds a 10 percent or greater beneficial interest.

Each Bidder shall set forth such disclosure and complete and execute Exhibit D-2 and include same with its Bid submission.

VI. DISCLOSURE OF INVESTIGATIONS AND OTHER ACTIONS INVOLVING THE BIDDER

Bidders must complete and submit as part of its Bid submission, the Disclosure of Investigations and Other Actions Involving the Vendor (Bidder) which is included herein as Exhibit D-3.

VII. NON-COLLUSION CERTIFICATION

No Bid shall be accepted from any Bidder who has directly or indirectly entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive bidding for the Contract.

No Bid shall be accepted from any Bidder who has employed or retained any person or selling agency to solicit or secure the Contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee.

Each Bidder shall complete, execute and submit with its Bid Exhibit D-4 hereof.

VIII. ACKNOWLEDGEMENT OF ADDENDA

Bidders must complete and submit as part of its Bid submission, the Acknowledgement of Addenda, which is included herein as Exhibit C-4.

IX. AUTHORIZATION OF SIGNATORIES

The signatory for the Bidder must be duly authorized, and documentation supporting said authorization must be submitted with the Bid in the form of completed and properly executed Exhibits E-1 and E-2 or E-3, E-4, E-5 or E-6, as appropriate.

The signatory on all Bid Bonds, Consents of Surety and Performance and Payment Bonds shall be the Attorney-in-Fact for the Surety, and each such document shall be accompanied by a certified and effectively dated Power of Attorney for the Attorney-in-Fact. No Power of Attorney shall be accepted if the required Bonds exceed the monetary or time specific limitations set forth in said Power of Attorney.

X. NEW JERSEY PUBLIC WORKS CONTRACTOR REGISTRATION

Pursuant to the Public Works Contractor Registration Act, N.J.S.A. 34:11-56.48 et seq. The Successful Bidder shall provide its Public Works Contractor Registration prior to award of the Contract. All Subcontractors required to be listed shall provide a Public Works Contractor Registration prior to award of the Contract. However, to facilitate the Bid evaluation and Contract award process, Bidders are encouraged to submit a copy of its valid Public Works Contractor Registration and those of all Subcontractors identified in Exhibit C-2, with its Bid. No Bidder or Subcontractor, including a Subcontractor not listed in the Bid proposal, shall engage in performance of any public work subject to the Contract, unless the Bidder is registered pursuant to the Public Works Contractor Registration Act, N.J.S.A. 34:11-56.48 et seq. Additionally, the Successful Bidder shall comply with all requirements of the Act before and after award, whether or not listed below and including the following:

10.1 - The requirement of proof of New Jersey Public Works Contractor Registration extends down through all levels (tiers) of the Project.

10.2 - No Bidder shall list a Subcontractor in its Bid proposal unless the Subcontractor is registered pursuant to the Public Works Contractor Registration Act, N.J.S.A. 34:11-56.48 et seq. at the time the Bid is submitted. It shall be the Bidder's responsibility to obtain proof of registration for all Subcontractors identified in Exhibit C-2 and to provide such proof to the Authority within one business day of request, at any time following Bid submission.

10.3 - No Bidder or Subcontractor, including a Subcontractor of any tier, shall engage in performance of any public work subject to the Contract, unless the Bidder is registered to the Public Works Contractor Registration Act, N.J.S.A. 34:11-56.48, et seq. Subcontractors not specifically identified in Exhibit C-2, must be registered with the Department of Labor pursuant to N.J.S.A. 34:11-56.48, et seq. prior to physically starting work on the Project. The Successful Bidder must provide a Public Works Contractor Registration within three (3) calendar days before a Subcontractor is on site.

10.4 - The Successful Bidder is responsible for determining the registration status of all of its Subcontractors unless previously provided pursuant to these specifications, after award of the Contract. The Successful Bidder shall ensure that the Authority has received proof of registration as to each Subcontractor identified in Exhibit C-2 or any other Subcontractor required by the specification before that Subcontractor's performance of Work on the Project.

XI. CHECKLIST OF SUBMITTED BID DOCUMENTS

Bidders must initial and submit the Bid Document Submission Checklist as part of its Bid submission, which is included herein as Exhibit B-1.

XII. FEDERAL NON-DEBARMENT CERTIFICATION

Bidders must submit a Federal Non-Debarment Certification, which is attached as Exhibit D-6 to this RFB. Bidders shall provide the Authority with a completed Federal Non-Debarment Certification prior to the date of the Contract Award.

XIII. PROJECT LABOR AGREEMENT

The Successful Bidder for this Project will be required to enter into a Project Labor Agreement ("PLA") with the relevant labor unions. The form of PLA is attached to these Bid Documents in Appendix C. The Bidder's Bid shall include the cost of such PLA. Bidders shall be required to submit with their Bid, a Letter of Assent to the PLA in the form included as Exhibit G-4.

Failure by the Successful Bidder to enter into the PLA after award of the Contract and within the time frame for endorsing the Contract shall be cause for the Authority to consider the Contract abandoned by the Successful Bidder. The Authority will thereafter pursue the remedies allowed in Section 5 "Failure to Enter into Contract" including forfeiture of the Successful Bidder's Bid Security.

XIV. BYRD ANTI-LOBBYING AMENDMENT CERTIFICATION

The Bidder must submit the Byrd Anti-Lobbying Amendment Certification, which is attached as Exhibit G-6. The Contractor shall certify that it will not and has not used federally appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with the awarding of any federal contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.

XV. FEDERAL REQUIREMENTS – 2 CFR PART 200 APPENDIX II

This Project is being funded partially through State and Federal Grants awarded by the State of New Jersey. The Federal Grant funding is through the Coronavirus State Fiscal Recovery Fund-G2023-79 under the American Rescue Plan Act of 2021, P.L. 117-2, as amended. Consequently, this RFB and the Contract involved includes and incorporates the contract requirements under Federal funding procurement awards in accordance with 2 CFR Part 200 Appendix II. These contract requirements are set forth herein and in the form of Contract attached hereto as Appendix B.

SECTION 4
CONTRACT SELECTION PROCESS

I. SELECTION PROCESS

Pursuant to N.J.S.A. 40A:11-24, the Authority shall award the Contract or reject all bids within a period up to sixty (60) calendar days following the Bid submission, except that the bids of any Bidders who consent thereto may, at the request of the Authority, be held for consideration of such longer period as may be agreed. Bids will be compared on the basis of their compliance with the requirements of the Project Specifications set forth in Appendix D. The Contract will be awarded to the Bidder who submits the bid with the lowest Bid Price as specified in Exhibit C-1, provided the Bidder is deemed responsible and the Bid complies with all requirements of the Contract. Bidders must bid on all items. Once Bids have been opened, unless withdrawn in accordance with Section 1(VI) herein, they shall remain firm for a period of sixty (60) calendar days.

In evaluating Bids, discrepancies between words and figures shall be resolved in favor of words. Discrepancies between unit prices and the total price extension shall be resolved in favor of the unit price and the extension adjusted accordingly. Discrepancies between the indicated sum of any column of figures and the correct sum thereof shall be resolved in favor of the correct sum.

Conditional or Partial Bids shall not be accepted.

II. CAUSES FOR REJECTING BIDS

The Authority reserves the right to waive any minor informality in or reject any and all Bids in accordance with the Local Public Contracts Law. The Authority further reserves the right to reject any Bid if the evidence submitted by, or investigation of such Bidder fails to satisfy the Authority that such Bidder is properly qualified as the lowest responsible, responsive Bidder to carry out the obligations of the Contract and to complete the Work contemplated in the RFB. Bids may be rejected for any of the following reasons:

A. All Bids pursuant to N.J.S.A. 40A:11-13.2;
   i. The lowest Bid substantially exceeds the cost estimates for the Project;
   ii. The lowest Bid substantially exceeds the Authority's appropriation for the Project;
   iii. The governing body of the Authority decides to abandon the Project;
   iv. The Authority wants to substantially revise the specifications for the Project;
   v. The purposes or provisions or both of N.J.S.A. 40A:11-1 et seq. are being violated;
   vi. The Authority decides to use a State authorized Contract pursuant to N.J.S.A. 40A:11-12.

B. If more than one Bid is received from an individual, firm or partnership, corporation or association under the same name;

C. Multiple Bids are received from an agent representing competing Bidders;

D. The Bid is inappropriately unbalanced;

E. The Bid is conditional or is a partial Bid;

F. The Bidder is determined to possess, pursuant to N.J.S.A. 40A:11-4b, prior negative experience;

G. If the Successful Bidder fails to enter into a contract within 21 days of Contract award, Saturdays, Sundays and holidays excepted, or as otherwise agreed upon by the parties to the Contract. In this case at its option, the Authority may accept the Bid of the next lowest responsible Bidder. (N.J.S.A. 40A:11-24b)

SECTION 5
CONTRACT AWARD/CONTRACT SUBMISSION REQUIREMENTS

The Contract will be awarded to the lowest responsible, responsive Bidder as found in N.J.S.A. 40A:11-16.c.

The Contract shall be signed by all parties within the time limit set forth in the specifications, which shall not exceed 21 days, Sundays and holidays excepted, after the making of the award; provided, however, that all parties to the Contract may agree to extend the limit set forth in the specifications beyond the 21day limit required in this subsection. The Successful Bidder, upon written request to the Authority, is entitled to receive, within seven (7) days of the request, an authorization to proceed pursuant to the terms of the Contract on the date set forth in the Contract for work to commence, or, if no date is set forth in the Contract, upon receipt of authorization.

The Contract may be executed in any number of counterparts, each of which shall be deemed to be an original, but all such counterparts shall constitute but one and the same instrument. Final execution by the Authority shall only occur upon the Successful Bidder's satisfactory execution of all documents required in the RFB.

After the award of the Contract and prior to the start of the Work, a preconstruction meeting shall be scheduled by the Authority. The Authority, the responsible engineer, the environmental and construction inspectors, and the Successful Bidder must be present at the preconstruction meeting.

Failure to Enter Into Contract

Should the Successful Bidder fail or refuse to execute the Contract and submit the other required documents, if any, within the time period set forth in this RFB, the Authority shall have the right to consider the Successful Bidder to have abandoned the Contract and the Authority may proceed to award the Contract to the next lowest responsive and responsible Bidder or re-advertise same, whichever shall be determined to be in the Authority's best interest.

The Successful Bidder, upon failure or refusal to execute and deliver the Contract, the Contract Bond(s), and any other documents or submissions required by the RFB, shall forfeit to the Authority, the Bid Security required as part of this RFB.

SECTION 6
CONTRACT TERM

The Contract Term commences on the date of the execution of the Contract and continues through Final Completion of the Project.

The Successful Bidder shall be required to perform all Work and furnish all materials, supplies, tools, labor, and equipment specified, necessary, proper, and incidental to the Work set forth in the Project Specifications provided in Appendix D The Successful Bidder in carrying out this obligation, must employ such methods or means as will not cause any interruption of or an interference with any activities of the Authority at the site of the Work. Failure to commence the Work in accordance with the Notice to Proceed will subject the Successful Bidder to the penalties set forth in the Contract.

SECTION 7
MISCELLANEOUS

7.1 - The Contract incorporates all State, Federal, and municipal statutes, laws, ordinances, rules and regulations existing at the time of the Bid submission date and as may be amended, supplemented or enacted during the term of the Contract, to the extent applicable to the Contract and/or the Work; and said statutes, laws, ordinances, rules and regulations shall be deemed to be included in the body of the Contract as though written out in full.

7.2 - The Contract shall be governed by the laws of the State of New Jersey.

7.3 - The Successful Bidder shall keep informed of all existing and future laws, rules, ordinances and regulations, local, State and National, in any manner affecting the Work herein specified and shall at all times observe and comply with said laws, rules, ordinances, and regulations and shall protect and indemnify the Authority, its Officers, and agents against any claim or liability arising from or based on the violation of such laws.

7.4 - Bidders and their subcontractors must be able to provide a Unique Entity ID (UEI) from Sam.Gov (the System of Award Management) and must maintain an active SAM registration through Final Completion of the Project.

7.5 - Neither an extension of time for any reason beyond the date originally stipulated herein for the completion of the Work nor the acceptance of any part of the Work called for by the Contract, shall be deemed to be a waiver by the Authority of the right to abrogate the Contract for abandonment or delay in the manner provided herein. Payment of money under the Contract, the acceptance or possession taken of the Work done by the Successful Bidder, or any estimate or certificate given shall not be evidence of the performance of the Contract or be construed as a waiver of any of its provisions by the Authority, nor shall any waiver of any breach of the Contract be held to be a waiver of any other or subsequent breach.

7.6 - The Successful Bidder shall maintain all documentation related to products, transactions or services under the Contract for a period of five (5) years or such other period as required by the Authority, from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request.

7.7 - Uniformed law enforcement officers will be required for this Project and shall be the responsibility of the Successful Bidder.

7.8 - The Successful Bidder shall cause appropriate provisions to be inserted in all subcontracts relative to the Contract to bind Subcontractors to the terms of the Contract insofar as applicable to the Work of Subcontractors and to give the Successful Bidder the same power as regards termination of any subcontract that the Authority may exercise over the Contractor under any provisions of the Contract Documents. Nothing contained in the Contract shall create any contractual relations between any Subcontractor and the Authority.

7.9 - The Successful Bidder is advised of its responsibility, as applicable, to file an annual disclosure statement of political contributions with the New Jersey Election Law Enforcement Commission (ELEC) pursuant to N.J.S.A. 19:44A-20.27 if they receive public contracts in excess of $50,000 in the aggregate from public entities in a calendar year. The Successful Bidder is responsible for determining if such filing is necessary. Additional information on this requirement is available from ELEC at www.elec.state.nj.us.

7.10 The Authority shall certify availability of funds prior to the award of the Contract.

7.11 Debarment and Suspension (Executive Orders 12549 and 12689)—A Contract award shall not be made to any Bidder listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

APPENDIX A

FORMS

EXHIBITS A1 and A2

MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE

EXHIBIT A-1
N.J.S.A. 10:5-31 et seq., N.J.A.C. 17:27
MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE

CONSTRUCTION CONTRACTS

During the performance of this contract, the Contractor agrees as follows:

The Contractor or Subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the Contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The Contractor or Subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

The Contractor or Subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the Contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The Contractor or Subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer, pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

When hiring or scheduling workers in each construction trade, the Contractor or Subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by N.J.A.C. 17:27-7.2; provided, however, that the Dept. of LWD, Construction EEO Monitoring Program, may, in its discretion, exempt a Contractor or Subcontractor from compliance with the good faith procedures prescribed by the following provisions, A, B, and C, as long as the Dept. of LWD, Construction EEO Monitoring Program is satisfied that the Contractor or Subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the

Dept. of LWD, Construction EEO Monitoring Program, that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with N.J.A.C. 17:27-7.2. The Contractor or Subcontractor agrees that a good faith effort shall include compliance with the following procedures:

(A) If the Contractor or Subcontractor has a referral agreement or arrangement with a union for a construction trade, the Contractor or Subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the Contractor or Subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et. seq., as supplemented and amended from time to time and the Americans with Disabilities Act. If the Contractor or Subcontractor is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the Contractor or Subcontractor agrees to afford equal employment opportunities minority and women workers directly, consistent with this chapter. If the Contractor's or Subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities as specified in this chapter, the Contractor or Subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the hiring or scheduling procedures prescribed under (B) below; and the Contractor or Subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.

(B) If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (A) above, or if the Contractor does not have a referral agreement or arrangement with a union for a construction trade, the Contractor or Subcontractor agrees to take the following actions:

(l) To notify the public agency compliance officer, the Dept. of LWD, Construction EEO Monitoring Program, and minority and women referral organizations listed by the Division pursuant to N.J.A.C. 17:27-3.3, of its workforce needs, and request referral of minority and women workers;

(2) To notify any minority and women workers who have been listed with it as awaiting available vacancies;

(3) Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the Contractor or Subcontractor has a referral agreement or arrangement with a union for the construction trade;

(4) To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the Contractor or Subcontractor has a referral agreement or arrangement with a union for the construction trade,

the State Training and Employment Service and other approved referral sources in the area;

(5) If it is necessary to lay off some of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and nondiscrimination standards set forth in this regulation, as well as with applicable Federal and State court decisions;

(6) To adhere to the following procedure when minority and women workers apply or are referred to the Contractor or Subcontractor:

(i) The contactor or Subcontractor shall interview the referred minority or women worker.

(ii) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the Contractor or Subcontractor shall in good faith determine the qualifications of such individuals. The Contractor or Subcontractor shall hire or schedule those individuals who satisfy appropriate qualification standards in conformity with the equal employment opportunity and non-discrimination principles set forth in this chapter. However, a Contractor or Subcontractor shall determine that the individual at least possesses the requisite skills, and experience recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Dept. of LWD, Construction EEO Monitoring Program. If necessary, the Contractor or Subcontractor shall hire or schedule minority and women workers who qualify as trainees pursuant to these rules. All of the requirements, however, are limited by the provisions of (C) below.

(iii) The name of any interested women or minority individual shall be maintained on a waiting list, and shall be considered for employment as described in (i) above, whenever vacancies occur. At the request of the Dept. of LWD, Construction EEO Monitoring Program, the Contractor or Subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.

(iv) If, for any reason, said Contractor or Subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the Contractor or Subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Dept. of LWD, Construction EEO Monitoring Program.

(7) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the

Dept. of LWD, Construction EEO Monitoring Program and submitted promptly to the Dept. of LWD, Construction EEO Monitoring Program upon request.

(C) The Contractor or Subcontractor agrees that nothing contained in (B) above shall preclude the Contractor or Subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the targeted county employment goal, the Contractor or Subcontractor shall consider for employment persons referred pursuant to (B) above without regard to such agreement or arrangement; provided further, however, that the Contractor or Subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the Contractor or Subcontractor agrees that, in implementing the procedures of (B) above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

After notification of award, but prior to signing a construction contract, the Contractor shall submit to the public agency compliance officer and the Dept. of LWD, Construction EEO Monitoring Program an initial project workforce report (Form AA-201) electronically provided to the public agency by the Dept. of LWD, Construction EEO Monitoring Program, through its web-site, for distribution to and completion by the Contractor, in accordance with N.J.A.C. 17:27-7. The Contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Dept. of LWD, Construction EEO Monitoring Program, and to the public agency compliance officer.

The Contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is necessary, for on-the-job and/or off-the-job programs for outreach and training of minorities and women.

(D) The Contractor and its Subcontractors shall furnish such reports or other documents to the Dept. of LWD, Construction EEO Monitoring Program as may be requested by the Dept. of LWD, Construction EEO Monitoring Program from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Dept. of LWD, Construction EEO Monitoring Program for conducting a compliance investigation pursuant to N.J.A.C. 17:27-1.1 et seq.

EXHIBIT A-2
41 C.F.R. § 60-1.4(b)
MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE

During the performance of this contract, the contractor agrees as follows:

(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following:

Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

(2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

(4) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(5) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(6) The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(7) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(8) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance:

Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

The applicant further agrees that it will be bound by the above equal opportunity clause with respect to its own employment practices when it participates in federally assisted construction work: Provided, That if the applicant so participating is a State or local government, the above equal opportunity clause is not applicable to any agency, instrumentality or subdivision of such government which does not participate in work on or under the contract.

The applicant agrees that it will assist and cooperate actively with the administering agency and the Secretary of Labor in obtaining the compliance of contractors and subcontractors with the equal opportunity clause and the rules, regulations, and relevant orders of the Secretary of Labor, that it will furnish the administering agency and the Secretary of Labor such information as they may require for the supervision of such compliance, and that it will otherwise assist the administering agency in the discharge of the agency's primary responsibility for securing compliance.

The applicant further agrees that it will refrain from entering into any contract or contract modification subject to Executive Order 11246 of September 24, 1965, with a contractor debarred from, or who has not demonstrated eligibility for, Government contracts and federally assisted construction contracts pursuant to the Executive Order and will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by the administering agency or the Secretary of Labor pursuant to Part II, Subpart D of the Executive Order. In addition, the applicant agrees that if it fails or refuses to comply with these undertakings, the administering agency may take any or all of the following actions: Cancel, terminate, or suspend in whole or in part this grant (contract, loan, insurance, guarantee); refrain from extending any further assistance to the applicant under the program with respect to which the failure or refund occurred until satisfactory assurance of future compliance has been received from such applicant; and refer the case to the Department of Justice for appropriate legal proceedings.

EXHIBIT B-1

BID DOCUMENT
SUBMISSION CHECKLIST
UNION COUNTY IMPROVEMENT AUTHORITY

I, the undersigned, certify that the following documents identified below to be included with the Bid proposal, have been completed and executed in ink and are hereby submitted pursuant to the terms of the above referenced Specifications and Contract Documents in the sealed Bid package. I understand that those documents marked with a "*" are not statutorily required at time of Bid, but are mandatory prior to award, for the Bidder or for any Subcontractors; therefore, the Authority is requesting that the Bidder submit these documents with its Bid submission.

I further understand that submission of the **Documents specifically marked with an "X" below are mandatory** and failure to submit them with the Bid is a mandatory cause for the Bid to be rejected (N.J.S.A. 40A:11-23.2). Failure to submit any of the other documents listed below, may be cause for the Bid to be rejected.

			Re
	Bid Document Submission Checklist	Exhibit B-1	_____
X	**Bid Proposal/Schedule of Prices**	Exhibit C-1	_____
X	**List of Subcontractors (N.J.S.A. 40A:11-16)**	Exhibit C-2	_____
	Certification of Construction Equipment	Exhibit C-3	_____
X	**Acknowledgment of Addenda**	Exhibit C-4	_____
	Acknowledgment of the Truth in Contracting Law	Exhibit C-5	_____
	Forms for Bidder:		
	State Debarred, Suspended and Disqualified Bidder Statement	Exhibit D-1	_____
X	**Ownership Disclosure Form (N.J.S.A. 52:25-24.2)**	Exhibit D-2	_____
	Disclosure of Investigations & Other Actions Involving Vendor Form	Exhibit D-3	_____
	Non-Collusion Certification	Exhibit D-4	_____
	Certification of New Jersey Business Registration	Exhibit D-5	_____
	Federal Non-Debarment Certification*	Exhibit D-6	_____
	Public Works Contractors Registration* (N.J.S.A. 34:11-56.48)	Certificate	_____
	Business Registration Certificate* (N.J.S.A. 52:32-44)	Certificate	_____
	Public Works Contractors Registration for Listed Subcontractor(s)* Certificate(s)		_____
	Business Registration Certificate for Listed Subcontractor(s)* Certificate(s)		_____

	Person Authorized to Sign Bid Documents of Corporation Bidder	Exhibit E-1	_____
	Corporate Resolution Authorizing Person to Sign Bid Documents	Exhibit E-2	_____
	Copy of Corporate Resolution	Resolution	_____
	Person Authorized to sign Bid Documents of Individual Bidder	Exhibit E-3	_____
	Person Authorized to sign Bid Documents of Partnership Bidder	Exhibit E-4	_____
	Person Authorized to sign Bid Documents of Limited Liability Company Bidder	Exhibit E-5	_____
	Person Authorized to sign Bid Documents of Joint Venture Bidder	Exhibit E-6	_____
X	**Bid Bond/ Certified/Cashier's Check (N.J.S.A. 40A:11-21)**	Exhibit F-1	_____
X	**Consent of Surety as to Performance and Payment Bond (N.J.S.A. 40A:11-22)**	Exhibit F-2	_____
X	**Consent of Surety as to General Maintenance Bond**	Exhibit F-3	_____
	Bidder's Certification of Equal Employment Opportunity	Exhibit G-1	_____
	Americans with Disabilities Act of 1990	Exhibit G-2	_____
	Prompt Payment Certification	Exhibit G-3	_____
	Project Labor Agreement Letter of Assent	Exhibit G-4	_____
	Request for Information (RFI)	Exhibit G-5	_____
	Byrd Anti-Lobbying Amendment Certification	Exhibit G-6	_____

SIGNATURE: The undersigned hereby acknowledges and has submitted the above listed requirements.

_____
Name of Bidder
(To be completed by Authorized Representative)

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

PLEASE NOTE:

*** Submission of the NJ Business Registration Certificate ("BRC"), NJ Public Works Contractor Registration ("PWCR"), and Federal Non-Debarment Certification are not required at time of bid submission for the Bidder or for any Subcontractors. However, the Authority is requesting that the Bidder submit these documents with its Bid submission. If the BRC, PWCR, or Federal Non-Debarment Certification are not included with the Bid submission, they must be submitted by the Bidder prior to the Contract award. Further, there must be a valid current PWCR in place at the time of Bid submission.**

"X" Failure to submit these documents marked with an "X" with the Bid submission will result in the rejection of the Bid pursuant to N.J.S.A. 40A:11-23.2.

EXHIBIT C-1

BID PROPOSAL/SCHEDULE OF PRICES

NAME OF BIDDER: _____

THE BIDDER IS DOING BUSINESS AS (Indicate "An Individual", "A Firm or Partnership", "A Corporation, "A Limited Liability Company", "A Joint Venture"):

_____

MAILING ADDRESS FOR NOTICES TO BIDDER:

_____

_____

STREET ADDRESS FOR COURIER DELIVERY OF NOTICES TO BIDDER:

_____

TELEPHONE NUMBER OF BIDDER:

(Business #) _____
(Telefax #) _____
(Emergency #) _____
(Email) _____

"AUTHORIZED REPRESENTATIVE OF BIDDER"[1]:

NAME _____

TITLE _____

ADDRESS _____

_____

AGENT WITHIN NEW JERSEY UPON WHOM SERVICE SHALL BE MADE IN THE EVENT OF LITIGATION:

NAME _____

_____

[1] The Authorized Representative of Bidder is any member, committee, officer, or representative of the Bidder duly authorized to execute the Contract on behalf of the Bidder. If the Bid is made by an individual, then the Authorized Representative shall be the individual; if made by a firm or partnership, the Authorized Representative shall be any of the general partners; if made by a corporation, the Authorized Representative shall be an official authorized by the corporation as evidenced by Corporate Resolution; if made by a Joint Venture, the Authorized Representative of the Joint Venture shall be the Authorized Representative of each member of the Joint Venture as indicated above for each entity

ADDRESS _____

_____

TELEPHONE _____

DESIGNATED BIDDER'S REPRESENTATIVE FOR QUESTIONS, PROBLEMS, PROCEDURAL REQUIREMENTS AND CONTRACT MATTERS:

NAME _____

ADDRESS _____

TELEPHONE #: _____

The above referenced Bidder offers and agrees, if this Bid is accepted, to enter into an agreement with the Authority to furnish all Work for the Contract Price set forth below and within the Contract Term indicated in the RFB and in accordance with the Contract Documents.

Bidder declares that no person or persons other than those named herein are interested in this Bid; that this Bid is made without collusion with any other person, firm or corporation; and that no person or persons acting in any official capacity for the Authority are directly or indirectly interested in this Bid, or in any portion of the profit thereof.

Bidder further agrees as follows: 1) that this Bid shall remain open and may not be withdrawn as set forth in the RFB; 2) that the Bidder accepts all of the terms and conditions set forth in the RFB including, without limitation, those dealing with the disposition of Bidder's Bid Security; 3) and that, upon acceptance of this Bid, Bidder will execute the Contract and will make all other submissions and furnish the required Contract Security within the time period(s) set forth in the Specifications and Contract Documents.

In accordance with the above understandings and agreements, Bidder will furnish the Work for the unit prices or prices set forth below:

BID PROPOSAL

1. The undersigned Bidder declares:

   - That this Bid Proposal is made, without collusion with any other person, firm or corporation;
   - That the Bidder has carefully examined the RFB, Addenda, and all other Contract Documents;
   - That the Bidder has carefully examined the locations, conditions and classes of material for the proposed Work;
   - That it will provide all necessary design services, machinery, tools, apparatus and other means of construction and will do all Work and furnish all the materials called for in the Contract Documents in the manner therein prescribed; and
   - That this Bid Proposal includes all applicable insurance expenses and policy costs allocated to the on-site activities of the Project as respects Workers' Compensation, Employer's Liability, Commercial General Liability, Owners Contractors Protective Liability, and Excess/Umbrella Liability.

2. In submitting this Bid Proposal, the Bidder agrees:

   - That the Authority has the right to reject this Bid Proposal in accordance with the terms of the RFB.
   - To hold this Bid Proposal open for a period of sixty (60) calendar days from the Bid Due Date, unless this time period is extended by mutual agreement of the Bidder and the Authority.
   - To accomplish the Scope of Work at the Bid Proposal, in accordance with the Contract Documents.

3. The Bid Proposal shall include:

   - Total amount for the furnishing of all design and construction administration services, labor, materials, services, equipment and appliances required in connection with and properly incidental to all Work, in conformance with all Contract Documents. The price of allowances listed in the Specifications and/or by Addenda (um) must be included in the Bidder's Total Lump Sum Bid Proposal. The Bidder understands that the use of the allowance shall be only as directed by the Authority for Authority purposes and only by Change Order that indicates the amounts to be charged to the allowance. Bidders shall refer to Drawings and Specification Section 012100 for additional allowance information.

     In case of a discrepancy between the amount shown in words and the amount shown in figures, the amount shown in words shall govern.

TOTAL LUMP SUM BID PROPOSAL:
The Total Lump Sum Bid Proposal Amount shall include $1,250,000.00 in Allowances

_____
(In Words)

$_____
(In Figures)

IN WITNESS WHEREOF, the Bidder has caused this instrument to be signed, attested to and sealed.

Bidder:_____
(Legal Firm Name)

By:_____ _____
(Signature) (Print or Type Name)

Title:_____

Address:_____

_____

Affix corporate seal here

Telephone No.:_____

Fax No.:_____

Date:_____

Witness:_____

Print or Type Name of Bidder:_____

Date:_____

UNIT PRICES

Bidders shall refer to Drawings and Specification Section 012200 for additional Unit Price information. Provide price to furnish and install, as a base line for changes that deviate from the Project Specifications, not for purposes for determining the low bid:

UNIT PRICE BREAKDOWN:

Unit Price No. 1: **20A duplex Electrical Receptacle** (each location) including a minimum of 50 feet of 2#12+1#12GND MC cable including supports, backbox, faceplate and all terminations fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each location: $ _____

Unit Price No. 2: **2#12+1#12GND MC cable** including supports, in accordance with the specifications. Unit of Measurement: Per Linear Foot (LF).

Per Linear foot: $ _____

Unit Price No. 3: **Tele/Data Jacks**, including (2) RJ-45 CAT6 jacks, 250 feet each of (2) CAT6 cables including supports, terminations and testing fully complete, all in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

Unit Price No. 4: Exit Sign, fixture type "E1" including minimum of 50 feet of 2#12+1#12GND MC cable including supports, backbox and all terminations, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

Unit Price No. 5: Digital lighting control "CO1" including all sensors, wall button stations, power packs and programming fully complete, in accordance to the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

Unit Price 6: Fire Alarm Horn/Strobe, including 100 feet of 2#14 FPLP MC cable, backbox and terminations fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

Unit Price No. 7: Smoke Detector, Ceiling Mounted, including 100 feet of 2#16 FPLP MC cable, backbox and terminations fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

Unit Price No. 8: Multicriteria Detector (smoke and carbon monoxide), Ceiling Mounted, including 100 feet of 2#16 FPLP MC cable, backbox and terminations fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

Unit Price No. 9: 1" Copper Pipe Type L, including all supports, couplings and insulation fully complete, in accordance with the specifications. Unit of Measurement: Per Linear Foot (LF).

Per Linear foot: $ _____

Unit Price No. 10: 1" Ball valve fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

Unit Price No. 11: Galvanized Ductwork including 22 gauge duct, including internal lining, supports fully complete, in accordance to the specifications. Unit of Measurement: Pounds (LBS).

Per Pound: $ _____

Unit Price No. 12: 1-1/2" Exterior duct insulation wrap fully complete, in accordance with the specifications. Unit of Measurement: Per Square Foot (SF).

Per Square Foot: $ _____

Unit Price No. 13: HVAC controls points, including sensors (thermostats, humidity sensors, pressure sensors) and connect to the DDC system via plenum rated wiring and all programming fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

Unit Price No. 14: Access Panels

Each Location: $ _____

Unit Price No. 15: **Removal and disposal of historic fill** in excess of 11,000 Cubic Yards. It is estimated that 11,000 Cubic Yards of cut will be required for the project. Soil removal and disposal up to that amount are to be included in the contractor's bid. Note this is a Cubic Yard amount. The GC is to provide verification that removals have exceeded the required cubic yard volume before unit costs will be utilized. This unit price for additional removal and disposal of historic fill, if needed, and will be calculated by weight.

Cost per ton: $ _____

Unit Price No. 16: Importing certified clean fill in excess of 0 Cubic Yards. It is estimated that the import of 0 CY of certified clean fill will be required in the contractor's bid. This unit price for additional import of certified clean fill, if needed.

Cost per ton: $ _____

Unit Price No. 17: Removal and disposal of excess contaminated soil not deemed to be historic fill.

Cost per ton: $ _____

AUTHORIZED SIGNATORY OF BIDDER:

_____ _____

Print Name and Title of Authorized Signatory

_____ _____

Signature of Bidder's Authorized Signatory

_____ _____

Date

EXHIBIT C-2

LIST OF SUBCONTRACTORS

If Bidder is not using any Subcontractors for any of the trades listed below, please certify here that the Bidder does not intend to use any Subcontractors for any of the trades listed.

Signature of Bidder

If Bidder is using any Subcontractors for any of the trades listed below, Bidder must complete the following:

In accordance with Local Public Contracts Law, N.J.S.A. 18A:64A-25.25b, the Bidder shall list below, the name and address of the Subcontractors whom he/she intends to employ in executing the portions of the work listed below, in the event that the Bidder is awarded the Contract. The Bidder shall also follow the Instructions to Bidders that are set forth below.

Subcontractors Name/Address	Work to be Performed	Trade
(1) _____	_____	Plumbing
(2) _____	_____	HVAC
(3) _____	_____	Electrical
(4) _____	_____	Structural Steel
(5) _____	_____	Ornamental Iron

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

INSTRUCTIONS TO BIDDER REGARDING SUBCONTRACTOR DISCLOSURES:

1. The Bidder must furnish a Business Registration Certificate and NJ Public Works Contractor Registration for each Subcontractor identified by the Bidder above, prior to the award of the Contract.

2. If the Bidder sets forth more than one Subcontractor for any of the trade categories above, the Bidder shall submit to the Authority a certificate signed by the Bidder listing each Subcontractor named in the Bid for that category. The certificate shall set forth the scope of work, goods, and services for which the Subcontractor has submitted a price quote and which the Bidder has agreed to award to each Subcontractor should the Bidder be awarded the Contract. The certificate shall be attached to this Exhibit C-2 by the Bidder. The certificate may take the form of a single certificate listing all Subcontractors or, alternatively, a separate certificate may be submitted for each Subcontractor. If a Bidder does not submit a certificate or certificates to the Authority, the Authority shall award the Contract to the next lowest responsible Bidder.

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

EXHIBIT C-3

CERTIFICATION OF CONSTRUCTION EQUIPMENT

I, the undersigned, hereby certify that the Bidder is the owner or lessee of the equipment necessary for the execution of this Contract, and further certify that the Bidder is fully prepared with the necessary capital, material, and machinery to conduct this work as herein specified.

The equipment available for the prosecution of the contract is listed below:

QUANTITY	DESCRIPTION AND CAPACITY	YEAR	CONDITION

(ATTACH ADDITIONAL SHEETS TO CONTINUE LIST AS NECESSARY)

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

EXHIBIT C-4

ACKNOWLEDGMENT OF ADDENDA

This Form must be signed and submitted by all Bidders regardless of whether any Addenda were issued. If no Addenda were issued, check the "No Addenda were issued box" and complete the signature section below:

The undersigned Bidder hereby acknowledges receipt of the following Addenda:

ADDENDA NO.	DATE RECEIVED	ACKNOWLEDGE RECEIPT (INITIAL)
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

□ **No Addenda were issued (check if applicable)**

_____
Name of Bidder

_____
Authorized Signature of Representative

_____
Print Name and Title of Signatory

_____
Date

EXHIBIT C-5

ACKNOWLEDGMENT OF THE TRUTH IN CONTRACTING LAW

Pursuant to N.J.S.A. 2C:21-34b. all Bidders are bound as follows:

"A person commits a crime if the person knowingly makes a material representation that is false in connection with the negotiation, award or performance of a government contract. If the contract amount is for $25,000.00 or above, the offender is guilty of a crime of the second degree. If the contract amount exceeds $2,500.00, but is less than $25,000.00, the offender is guilty of a crime of the third degree. If the contract amount is for $2,500.00 or less, the offender is guilty of a crime of the fourth degree."

I, the undersigned, hereby certify that I have read and understood the Truth in Contracting Law as provided above.

_____
Name of Bidder

_____
Authorized Signature of Representative

_____
Print Name and Title of Signatory

_____
Date

EXHIBIT D-1

NEW JERSEY STATE DEBARRED, SUSPENDED AND DISQUALIFIED BIDDER STATEMENT

I, the undersigned solemnly swear that _____ (Name of Bidder), at the time of the Bid, **is not included** on the New Jersey State Treasurer's List of Debarred, Suspended, or Disqualified Bidders and that all statements contained in the Bid and in this Statement are true and correct and made with the full knowledge that the Union County Improvement Authority relies upon the truth of the statements contained in the Bid and in the statements contained in this Statement in awarding the contract for the Work. Furthermore, I agree to immediately notify the Union County Improvement Authority wherever it appears that _____ (Name of Bidder) is on the aforementioned New Jersey State Treasurer List at any time prior to and during the life of the Contract.

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

EXHIBIT D-2

OWNERSHIP DISCLOSURE FORM

RESPONDENT NAME:
IN ACCORDANCE WITH N.J.S.A. 52:25-24.2, ALL PARTIES ENTERING INTO A CONTRACT WITH THE MIDDLESEX COUNTY UTILITIES AUTHORITY ARE REQUIRED TO PROVIDE A STATEMENT OF OWNERSHIP.

YES
NO

1. The Respondent is a **Non-Profit Entity**; and therefore, no disclosure is necessary.
2. The Respondent is a **Sole Proprietor**; and therefore, no other disclosure is necessary.
   A Sole Proprietor is a person who owns an unincorporated business by himself or her-self.
   A limited liability company with a single member is not a Sole Proprietor.
3. The Respondent is a **corporation, partnership, or limited liability company**.

   If you answered **YES** to Question 3, you must disclose the following: **(a)** the names and addresses of all stockholders in the corporation who own 10% or more of its stock, of any class; **(b)** all individual partners in the partnership who own a 10% or greater interest therein; or, **(c)** all members in the limited liability company who own a 10% or greater interest therein.*

NAME			
ADDRESS			
ADDRESS			
CITY	**STATE**	**ZIP**	

NAME			
ADDRESS			
ADDRESS			
CITY	**STATE**	**ZIP**	

NAME			
ADDRESS			
ADDRESS			
CITY	**STATE**	**ZIP**	

NAME			
ADDRESS			
ADDRESS			
CITY	**STATE**	**ZIP**	

YES
NO

4. For each of the corporations, partnerships, or limited liability companies identified above, are there any individuals, partners, members, stockholders, corporations, partnerships, or limited liability companies owning a 10% or greater interest of those listed business entities?

   If you answered **YES** to Question 4, you must disclose the following: **(a)** the names and addresses of all stockholders in the corporation who own 10% or more of its stock, of any class; **(b)** all individual partners in the partnership who own a 10% or greater interest therein; or, **(c)** all members in the limited liability company who own a 10% or greater interest therein. The disclosure(s) shall be continued until the names and addresses of every non-corporate stockholder, individual partner, and/or member a 10% or greater interest has been identified.*

NAME			
ADDRESS			
ADDRESS			
CITY	**STATE**	**ZIP**	

NAME			
ADDRESS			
ADDRESS			
CITY	**STATE**	**ZIP**	

NAME			
ADDRESS			
ADDRESS			
CITY	**STATE**	**ZIP**	

NAME			
ADDRESS			
ADDRESS			
CITY	**STATE**	**ZIP**	

5. As an alternative to completing this form, a Respondent with any direct or indirect parent entity which is publicly traded, may submit the name and address of each publicly traded entity and the name and address of each person that holds a 10% or greater beneficial interest in the publicly traded entity as of the last annual filing with the federal Securities and Exchange Commission or the foreign equivalent, and, if there is any person that holds a 10% or greater beneficial interest, also shall submit links to the websites containing the last annual filings with the federal Securities and Exchange Commission or the foreign equivalent and the relevant page numbers of the filings that contain the information on each person that holds a 10% or greater beneficial interest.*

EXHIBIT D-3

DISCLOSURE OF INVESTIGATIONS AND OTHER ACTIONS INVOLVING THE VENDOR FORM

BID SOLICITATION # AND TITLE: _____

VENDOR NAME: _____

PART 1

Please list all Officers/Directors of the Vendor below.

NAME				NAME			
TITLE				TITLE			
ADDRESS				ADDRESS			
ADDRESS				ADDRESS			
CITY	STATE	ZIP		CITY	STATE	ZIP	
NAME				NAME			
TITLE				TITLE			
ADDRESS				ADDRESS			
ADDRESS				ADDRESS			
CITY	STATE	ZIP		CITY	STATE	ZIP	

**Attach Additional Sheets If Necessary.*

PART 2

PLEASE REFER TO THE PERSONS LISTED ABOVE AND/OR THE PERSONS AND/OR ENTITIES LISTED ON THE OWNERSHIP DISCLOSURE FORM WHEN ANSWERING THESE QUESTIONS. PLEASE CIRCLE YOUR RESPONSE.

1. Has any person or entity listed on this form or its attachments ever been arrested, charged, indicted, or convicted in a criminal or disorderly persons matter by the State of New Jersey (or political subdivision thereof), or by any other state or the U.S. Government? **YES / NO**

2. Has any person or entity listed on this form or its attachments ever been suspended, debarred or otherwise declared ineligible by any government agency from bidding or contracting to provide services, labor, materials or supplies? **YES / NO**

3. Are there currently any pending criminal matters or debarment proceedings in which the firm and/or its officers and/or managers are involved? **YES / NO**

4. Has any person or entity listed on this form or its attachments been denied any license, permit or similar authorization required to engage in the work applied for herein, or has any such license, permit or similar authorization been revoked by any agency of federal, state or local government? **YES / NO**

5. Has any person or entity listed on this form or its attachments been involved as an adverse party to a public sector client in any civil litigation or administrative proceeding in the past five (5) years? **YES / NO**

IF ANY OF THE ANSWERS TO QUESTIONS 1-5 ARE "YES", PLEASE PROVIDE THE REQUESTED INFORMATION IN PART 3.
IF ALL OF THE ANSWERS TO QUESTIONS 1-5 ARE "NO", NO FURTHER ACTION IS NEEDED; PLEASE SIGN AND DATE THE FORM.

PART 3

DESCRIPTION OF THE INVESTIGATION OR LITIGATION, ETC.

If you answered "YES" to any of questions 1 - 5 above, you must provide a detailed description of any investigation or litigation, including, but not limited to, administrative complaints or other administrative proceedings involving public sector clients during the past five (5) years. The description must include the nature and status of the investigation, and for any litigation, the caption and a brief description of the action, the date of inception, current status, and if applicable, the disposition.

PERSON OR ENTITY NAME _____
CONTACT NAME _____ PHONE NUMBER _____
CASE CAPTION _____
INCEPTION OF THE INVESTIGATION _____ CURRENT STATUS _____
SUMMARY OF INVESTIGATION _____

**Attach Additional Sheets If Necessary.*

CERTIFICATION

I, the undersigned, certify that I am authorized to execute this certification on behalf of the Vendor, that the foregoing information and any attachments hereto, to the best of my knowledge are true and complete. I acknowledge that the Union County Improvement Authority ("UCIA") is relying on the information contained herein, and that the Vendor is under a continuing obligation from the date of this certification through the completion of any contract(s) with the UCIA to notify the UCIA in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification. If I do so, I may be subject to criminal prosecution under the law, and it will constitute a material breach of my contract(s) with the UCIA, permitting the UCIA to declare any contract(s) resulting from this certification void and unenforceable.

_____ _____
Signature Date

_____
Print Name and Title

EXHIBIT D-4

NON-COLLUSION CERTIFICATION

I, the undersigned, hereby certify, in accordance with N.J.S.A. 52:34-15, that the Bidder named below, has not, directly or indirectly entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive bidding in connection with the above named Contract; that all statements contained in said Proposal and in this Certification are true and correct, and made with full knowledge that the Union County Improvement Authority relies upon the truth of the statements contained in said Proposal and in the statements contained in this Certification in awarding the above referenced Contract.

I further certify that no person or selling agent has been employed or retained to solicit or secure such Contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, except bond fide employees or bona fide established commercial or selling agencies maintained by the Bidder.

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

EXHIBIT D-5

CERTIFICATION OF NEW JERSEY BUSINESS REGISTRATION

In accordance with N.J.S.A. 52:32-44(b), a Bidder and its named Subcontractors must have a valid Business Registration Certificate ("BRC") issued by the Department of Treasury, Division of Revenue and Enterprise Services prior to award of a contract. To facilitate the Bid evaluation and Contract award process, the Bidder is being requested to submit a copy of its valid BRC and those of all named Subcontractors with its Bid.

Any Bidder, inclusive of any name Subcontractors, who does not have a valid BRC as of the Bid Due Date or whose BRC was revoked prior to the Bid Due Date, should proceed immediately to register its business or seek reinstatement of a revoked BRC. The Bidder and its named Subcontractors may register with the Division of Revenue and Enterprise Services, obtain a copy of an existing BRC or obtain information necessary to seek reinstatement of a revoked BRC online at *http://www.state.nj.us/treasury/revenue/busregcert.shtml*.

Bidders are cautioned that it may require a significant amount of time to secure an initial BRC or the reinstatement of a revoked BRC. The process can require actions by both the Division of Revenue and Enterprise Services and the Division of Taxation. For this reason, a Bidder's attention to this requirement prior to bidding is highly recommended.

A Bidder, inclusive of all named Subcontractors, that was not business registered as of the Bid Due Date must be so registered and in possession of a valid BRC within five business days of its receipt of the Authority's written request for evidence of the BRC at the address stated in the Bid (the "BRC Request Deadline"). The Authority will deliver this request by hand, overnight delivery, or Certified FAX.

A Bidder who does not possess a valid BRC as of 5:00 p.m. prevailing time on the BRC Request Deadline date will be deemed ineligible for Contract award. If a Bidder possesses a valid BRC as of the BRC Request Deadline date but fails or refuses to provide evidence of same to the Authority, the Authority will rely upon information available from computerized systems maintained by the State as a basis to independently verify the Bidder's BRC status as of the BRC Request Deadline date and will be guided accordingly in its award process.

A Bidder receiving a Contract award as a result of this procurement and any Subcontractors utilized by that Bidder will be required to maintain a valid business registration with the Division of Revenue and Enterprise Services for the duration of the executed contract, inclusive of any contract extensions.

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

EXHIBIT D-6

UNION COUNTY IMPROVEMENT AUTHORITY
FEDERAL NON-DEBARMENT CERTIFICATION

N.J.S.A. 52:32-44.1

Summary of the Certification Requirements under N.J.S.A. 52:32-44.1

Pursuant to state law any natural person, company, firm, association, corporation, or other entity prohibited, or "debarred," from contracting with the federal government agencies, shall also be prohibited from contracting for public work in the State of New Jersey. This prohibition also extends to any affiliate organization(s) held by or subject to the control of an entity of that prohibited person or entity.

Prior to awarding a contract for public work a local unit must obtain written certification from the contracting person or entity through the form below, attesting to their non-debarment from contracting with federal government agencies. Accordingly, this certification shall be completed, certified to, and submitted to the contracting unit prior to contract award, except for emergency contracts where submission is required prior to payment.

PART I: VENDOR INFORMATION	
Individual or Organization Name	
Address of Individual or Organization	
DUNS Code (if applicable)	
CAGE Code (if applicable)	
Check the box that represents the type of business organization:	

☐Sole Proprietorship (skip Parts III and IV) ☐Non-Profit Corporation (skip Parts III and IV)

☐For-Profit Corporation (any type) ☐Limited Liability Company (LLC) ☐Partnership

☐Limited Partnership ☐Limited Liability Partnership (LLP)

☐Other (be specific): _____

PART II: CERTIFICATION OF NON-DEBARMENT: Individual or Organization			
I hereby certify that the individual or organization listed above in Part I is not debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the Union County Improvement Authority (the "**Authority**") is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the Authority to notify the Authority in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the Authority, permitting the Authority to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

PART III: CERTIFICATION OF NON-DEBARMENT: Individual or Entity Owning Greater than 50 Percent of Organization	
Section A (Check the Box that applies)	
☐	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of its voting stock, or of the partner in the partnership who owns more than 50 percent interest therein, or of the member of the limited liability company owning more than 50 percent interest therein, as the case may be.
Name of Individual or Organization	
Address (for Individual) or Business Address	
OR	
☐	No one stockholder in the corporation owns more than 50 percent of its voting stock, or no partner in the partnership owns more than 50 percent interest therein, or no member in the limited liability company owns more than 50 percent interest therein, as the case may be.

Section B (Skip if no Business entity is listed in Section A above)	
☐	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of the voting stock of the organization's parent entity, or of the partner in the partnership who owns more than 50 percent interest in the organization's parent entity, or of the member of the limited liability company owning more than 50 percent interest in organization's parent entity, as the case may be.
Stockholder/Partner/Member Owning Greater Than 50 Percent of Parent Entity	
Address (for Individual) or Business Address	
OR	
☐	No one stockholder in the parent entity corporation owns more than 50 percent of its voting stock, no partner in the parent entity partnership owns more than 50 percent interest therein, or no member in the parent entity limited liability company owns more than 50 percent interest therein, as the case may be.

Section C – Part III Certification

I hereby certify that no individual or organization that is debarred by the federal government from contracting with a federal agency owns greater than 50 percent of the **Organization listed above in Part I** or, if applicable, owns greater than 50 percent of a parent entity of the Organization. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the Union County Improvement Authority is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award the Authority to notify the Authority in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the Authority, permitting the Authority to declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print):		Title:	
Signature:		Date:	

Part IV: CERTIFICATION OF NON-DEBARMENT: Contractor – Controlled Entities	
Section A	
☐	Below is the name and address of the corporation(s) in which the **Organization listed in Part I** owns more than 50 percent of voting stock, or of the partnership(s) in which the **Organization listed in Part I** owns more than 50 percent interest therein, or of the limited liability company or companies in which the **Organization listed above in Part I** owns more than 50 percent interest therein, as the case may be.
Name of Business Entity	**Business Address**
Add additional sheets if necessary	
OR	
☐	The **Organization listed above in Part I** does not own greater than 50 percent of the voting stock in any corporation and does not own greater than 50 percent interest in any partnership or any limited liability company.

Section B (skip if no business entities are listed in Section A of Part IV)	
☐	Below are the names and addresses of any entities in which an entity listed in Part III A owns greater than 50 percent of the voting stock (corporation) or owns greater than 50 percent interest (partnership or limited liability company).
Name of Business Entity Controlled by Entity Listed in Section A of Part IV	**Business Address**
Add additional Sheets if necessary	
OR	
☐	No entity listed in Part III A owns greater than 50 percent of the voting stock in any corporation or owns greater than 50 percent interest in any partnership or limited liability company.
Section C – Part IV Certification	
I hereby certify that the **Organization listed above in Part I** does not own greater than 50 percent of any entity that that is debarred by the federal government from contracting with a federal agency and, if applicable, does not own greater than 50 percent of any entity that in turns owns greater than	

50 percent of any entity debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the Union County Improvement Authority is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the Authority to notify the Authority in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the Authority, permitting the Authority to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

INSTRUCTIONS FOR COMPLETING EXHIBIT E

If the Bidder is a corporation complete Exhibit E-1 and E-2 only.

If the Bidder is an individual complete Exhibit E-3 only.

If the Bidder is a partnership complete Exhibit E-4 only.

If the Bidder is a limited liability company complete Exhibit E-5 only.

If the Bidder is a joint venture, then each member of the joint venture must complete the authorization to sign bid documents that applies to each member's business organization as per Exhibit E-6.

EXHIBIT E-1

PERSON AUTHORIZED TO SIGN BID DOCUMENTS OF CORPORATION BIDDER

STATE OF _____)
) SS:
COUNTY OF _____)

Be it remembered that on this _____ day of _____, 20_____, _____ (Herein after known as the "Corporate Secretary"), personally appeared before the subscriber, a Notary Public. The Corporate Secretary being by me duly sworn on his/her oath does depose and make proof to my satisfaction that:

1. He/She is the Secretary of the Corporation mentioned in Exhibit C-1 of the attached Contract _____ (Herein after known as the "Contract"); and

2. _____
(Name and Title of person authorized to sign bid documents, herein after known as "Authorized Representative of the Bidder[1]") is a person authorized to sign bid documents for said Corporation; and

3. The execution and making of this Authorization To Sign Bid Documents has been duly authorized by a **proper resolution of the board of directors of said Corporation (Herein after referred to as the "Corporate Resolution); and said Corporate Resolution is attached to Exhibit E-2[2];** and

4. The Authorized Representative of Bidder signed Exhibit C-1 of the Contract in the presence of the Corporate Secretary. The Corporate Secretary then signed said Exhibit C-1 of the Contract thereto as witness, and for his/her voluntary act and deed, and as for the voluntary act and deed of said Corporation.

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

Sworn and subscribed to before me

this _____day of _____, 20_____.

_____

My commission expires on _____

[1]Authorized Representative of the Bidder means any member, committee, officer, or representative of the Bidder duly authorized to execute the Contract on behalf of the Bidder. If the Bid is made by an individual, then the Authorized Representative shall be the individual; if made by a firm or partnership, the Authorized Representative shall be all of the general partners; if made by a corporation, the Authorized Representative shall be an official authorized by the corporation as evidenced by Corporate Resolution; if made by a Joint Venture, the Authorized Representative of the Joint Venture shall be the Authorized Representative of each member of the Joint Venture as indicated above for each entity.

[2]**Note: Attach Corporate Resolution for person authorized to sign bid documents to Exhibit E-2.**

EXHIBIT E-2

CORPORATE RESOLUTION AUTHORIZING PERSON TO SIGN BID DOCUMENTS

The Corporate Resolution certifying the person authorized to sign bid documents for the corporation is attached hereto.

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

Attach Corporate Resolution to this Exhibit

EXHIBIT E-3

PERSON AUTHORIZED TO SIGN BID DOCUMENTS OF INDIVIDUAL BIDDER

STATE OF _____)
) SS:
COUNTY OF _____)

Be it remembered that on this _____ day of _____, 20_____, _____ (herein after known as the "Authorized Representative of the Bidder[1]"), personally appeared before the subscriber, a Notary Public. The Authorized Representative of the Bidder being by me duly sworn on his/her oath does depose and make proof to my satisfaction that:

1. He/She is the individual mentioned in Exhibit C-1 of the attached Contract_____ (Herein after known as the "Contract"); and

2. He/She signed Exhibit C-1 of the Contract for his/her voluntary act and deed.

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

Sworn and subscribed to before me

this _____day of _____, 20_____.

_____

My commission expires on _____

[1]Authorized Representative of the Bidder means any member, committee, officer, or representative of the Bidder duly authorized to execute the Contract on behalf of the Bidder. If the Bid is made by an individual, then the Authorized Representative shall be the individual; if made by a firm or partnership, the Authorized Representative shall be all of the general partners; if made by a corporation, the Authorized Representative shall be an official authorized by the corporation as evidenced by Corporate Resolution; if made by a Joint Venture, the Authorized Representative of the Joint Venture shall be the Authorized Representative of each member of the Joint Venture as indicated above for each entity.

EXHIBIT E-4

PERSON AUTHORIZED TO SIGN BID DOCUMENTS OF PARTNERSHIP BIDDER

STATE OF _____)
) SS:
COUNTY OF _____)

Be it remembered that on this _____ day of _____, 20_____, _____ (Herein after known as the "Authorized Representative of Bidder"[1]), personally appeared before the subscriber, a Notary Public. The Authorized Representative of Bidder being by me duly sworn on his/her oath does depose and make proof to my satisfaction that:

1. He/She is a general partner of the partnership mentioned in Exhibit C-1 of the attached Contract_____ Herein after known as the "Contract"); and

2. He/She signed Exhibit C-1 of the Contract for his/her voluntary act and deed, and as for the voluntary act and deed of said partnership.

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

Sworn and subscribed to before me

this _____day of _____, 20_____.

_____

My commission expires on _____

[1]Authorized Representative of the Bidder means any member, committee, officer, or representative of the Bidder duly authorized to execute the Contract on behalf of the Bidder. If the Bid is made by an individual, then the Authorized Representative shall be the individual; if made by a firm or partnership, the Authorized Representative shall be all of the general partners; if made by a corporation, the Authorized Representative shall be an official authorized by the corporation as evidenced by Corporate Resolution; if made by a Joint Venture, the Authorized Representative of the Joint Venture shall be the Authorized Representative of each member of the Joint Venture as indicated above for each entity.

EXHIBIT E-5

PERSON AUTHORIZED TO SIGN BID DOCUMENTS OF LIMITED LIABILITY COMPANY BIDDER

STATE OF _____)
) SS:
COUNTY OF _____)

Be it remembered that on this _____ day of _____, 20_____, _____ (Herein after known as the "Authorized Representative of Bidder"[1]), personally appeared before the subscriber, a Notary Public. The Authorized Representative of Bidder being by me duly sworn on his/her oath does depose and make proof to my satisfaction that:

1. He/She is the _____ (Insert title of Authorized Signatory) mentioned in Exhibit C-1 of the attached Contract_____ Herein after known as the "Contract"); and

2. He/She signed Exhibit C-1 of the Contract for his/her voluntary act and deed, and as for the voluntary act and deed of said Limited Liability Company.

_____
Name of Bidder

_____
Signature of Authorized Representative

_____
Print Name and Title of Signatory

_____
Date

Sworn and subscribed to before me

this _____day of _____, 20_____.

_____

My commission expires on _____

[1]Authorized Representative of the Bidder means any member, committee, officer, or representative of the Bidder duly authorized to execute the Contract on behalf of the Bidder. If the Bid is made by an individual, then the Authorized Representative shall be the individual; if made by a firm or partnership, the Authorized Representative shall be all of the general partners; if made by a corporation, the Authorized Representative shall be an official authorized by the corporation as evidenced by Corporate Resolution; if made by a Joint Venture, the Authorized Representative of the Joint Venture shall be the Authorized Representative of each member of the Joint Venture as indicated above for each entity.

EXHIBIT E-6

PERSON AUTHORIZED TO SIGN BID DOCUMENTS OF JOINT VENTURE BIDDER

If the Bidder is a joint venture, then each member of the joint venture must complete an Authorization of Signatory instrument that applies to each member's business organization.

EXHIBIT F-1

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we the undersigned,

_____, as Principal, and

_____, as Surety, are hereby held and firmly bound unto the Union County Improvement Authority, Elizabeth, New Jersey, in the sum of _____ Dollars, as liquidated damages for payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors administrators, successors and assigns.

The condition to the above obligation is such that whereas the Principal has submitted to the Union County Improvement Authority, a certain bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, providing work, service, equipment and/or supplies as set forth above.

NOW THEREFORE

(a) If said Bid shall be rejected, or in alternate,

(b) If said Bid shall be accepted and the Principal shall execute and deliver the Contract and shall furnish a bond for the faithful performance of said contract for the prompt payment of labor and material furnished in the prosecution thereof and for the environmental maintenance requirements thereof; and deliver evidence of insurance and such other documents as are required as conditions precedent to the Union County Improvement Authority's execution of the Contract, all within the times required in the Contract Documents; and shall in all other respects perform the agreement created by the acceptance of said bid,

Then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said surety and its bond shall be in no way impaired or affected by an extension of the time within which such bid may be accepted, and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the parties hereto duly executed this bond on

this _____ day of _____, 20_____.

_____
(Name of Principal)

BY: _____
Signature of Bidder's Authorized Representative

Delivered in the
presence of:

_____
(Name of Surety)

_____ By: _____
(As to Surety) Signature of Surety's
Attorney-In-Fact

EXHIBIT F-2

CONSENT OF SURETY
AS TO PERFORMANCE AND PAYMENT BOND

A Performance and Payment Bond in the amount of 100% of Contract Price will be required from the Successful Bidder, and consequently, all Bidders shall submit, with their bid, a certificate in substantially the following form:

TO: The Union County Improvement Authority

RE:_____
Bidder

Project: Renovation & Addition of the Union College of Union County Physical Education Center

_____
Contract Name

This is to certify that the _____ (Surety Company) will provide to _____ (Bidder) to the benefit of Union County Improvement Authority, a Performance and Payment Bond as set forth in the Request for Bids. Project Specifications and Contract Documents, each satisfying the requirements for the Bidder to provide work, service, equipment, and/or supplies, and pay all lawful claims of beneficiaries as defined by N.J.S.A. 2A:44-143 for labor performed or materials, provisions, provender or other supplies or teams, fuels, oils, implements or machinery furnished, used or consumed in the carrying forward, performing or completing of said Contract, as set forth in the Project Specifications and Contract Documents, in the event that said _____ (Bidder) is awarded a Contract for the above Project.

_____
Attorney-In-Fact of Surety Company**

**CONSENT OF SURETY MUST BE SIGNED BY AN ATTORNEY-IN-FACT OF A SURETY COMPANY AND NOT BY THE INDIVIDUAL OR COMPANY SUBMITTING THE BID AND MUST BE ACCOMPANIED BY A DULY NOTARIZED POWER-OF-ATTORNEY FOR THE ATTORNEY-IN-FACT.

EXHIBIT F-3

CONSENT OF SURETY AS TO GENERAL MAINTENANCE BOND

A General Maintenance Bond in the amount of 100% of the Final Contract Price for a term of __two_ (_2_) years following the date of the Notice of Contract Acceptance and Certification for Final Payment will be required from the Successful Bidder, and consequently, all Bidders shall submit, with their bid, a certificate in substantially the following form:

TO: The Union County Improvement Authority

RE:_____
Bidder

Project: Renovation & Addition of the Union College of Union County Physical Education Center

_____
Contract Name

This is to certify that the _____ (Surety Company) will provide to _____ (Bidder) to the benefit of Union County Improvement Authority, a General Maintenance Bond as set forth in the Project Specifications and Contract Documents, each satisfying the requirements for the Bidder to provide work, service, equipment, and/or supplies, as set forth the Specifications and Contract Documents, in the event that said _____ (Bidder) is awarded a Contract for the above project.

_____
Attorney-In-Fact of Surety Company**

**CONSENT OF SURETY MUST BE SIGNED BY AN ATTORNEY-IN-FACT OF A SURETY COMPANY AND NOT BY THE INDIVIDUAL OR COMPANY SUBMITTING THE BID AND MUST BE ACCOMPANIED BY A DULY NOTARIZED POWER-OF-ATTORNEY FOR THE ATTORNEY-IN-FACT.

EXHIBIT G-1

BIDDER'S CERTIFICATION OF EQUAL EMPLOYMENT OPPORTUNITY

By the submission of this bid and in accordance with Executive Order No. 11246, Section 202, dated September 24, 1965, the Bidder, offeror, applicant, or Subcontractor certifies that he shall not discriminate against any employee or applicant for employment because of age, race, color, creed, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. This obligation not to discriminate in employment includes, but is not limited to, the following:

HIRING, PLACEMENT UPGRADING, TRANSFER OR DEMOTION, RECRUITMENT, ADVERTISING, OR SOLICITATION, FOR EMPLOYMENT, TRAINING DURING EMPLOYMENT, RATES OF PAY OR OTHER FORMS OF COMPENSATION, SELECTION FOR TRAINING INCLUDING APPRENTICESHIP, LAYOFF, OR TERMINATION.

He further agrees that (except where he has obtained identical certifications from proposed Subcontractors for specific time periods) he will obtain identical certifications from proposed Subcontractors prior to the award of Subcontractors exceeding $10,000, which are not exempt from the provision of Equal Opportunity clause: that he will retain such certifications in his files, and that he will post in a conspicuous place and forward Notice of Non-Discrimination to such proposed Subcontractors (except where the proposed Subcontractors have submitted identical certification for specific time periods).

_____ _____

(Signature) (Date)

_____

(Name and Title of Signer – Please type)

EXHIBIT G-2

AMERICANS WITH DISABILITIES ACT OF 1990
Equal Opportunity for Individuals with Disability

The contractor and the Union County Improvement Authority, (hereafter the "Authority") do hereby agree that the provisions of Title 11 of the Americans With Disabilities Act of 1990 (the "Act") *(*42 U.S.C. 12101 et seq.), which prohibits discrimination on the basis of disability by public entities in all services, programs, and activities provided or made available by public entities, and the rules and regulations promulgated pursuant there unto, are made a part of this contract. In providing any aid, benefit, or service on behalf of the Authority pursuant to this contract, the contractor agrees that the performance shall be in strict compliance with the Act. In the event that the contractor, its agents, servants, employees, or subcontractors violate or are alleged to have violated the Act during the performance of this contract, the contractor shall defend the Authority in any action or administrative proceeding commenced pursuant to this Act. The contractor shall indemnify, protect, and save harmless the Authority, its agents, servants, and employees from and against any and all suits, claims, losses, demands, or damages, of whatever kind or nature arising out of or claimed to arise out of the alleged violation. The contractor shall, at its own expense, appear, defend, and pay any and all charges for legal services and any and all costs and other expenses arising from such action or administrative proceeding or incurred in connection therewith. In any and all complaints brought pursuant to the Authority's grievance procedure, the contractor agrees to abide by any decision of the Authority which is rendered pursuant to said grievance procedure. If any action or administrative proceeding results in an award of damages against the Authority, or if the Authority incurs any expense to cure a violation of the ADA which has been brought pursuant to its grievance procedure, the contractor shall satisfy and discharge the same at its own expense.

The Authority shall, as soon as practicable after a claim has been made against it, give written notice thereof to the contractor along with full and complete particulars of the claim, If any action or administrative proceeding is brought against the Authority or any of its agents, servants, and employees, the Authority shall expeditiously forward or have forwarded to the contractor every demand, complaint, notice, summons, pleading, or other process received by the Authority or its representatives.

It is expressly agreed and understood that any approval by the Authority of the services provided by the contractor pursuant to this contract will not relieve the contractor of the obligation to comply with the Act and to defend, indemnify, protect, and save harmless the Authority pursuant to this paragraph.

It is further agreed and understood that the Authority assumes no obligation to indemnify or save harmless the contractor, its agents, servants, employees and subcontractors for any claim which may arise out of their performance of this Agreement. Furthermore, the contractor expressly understands and agrees that the provisions of this indemnification clause shall in no way limit the contractor's obligations assumed in this Agreement, nor shall they be construed to relieve the contractor from any liability, nor preclude the Authority from taking any other actions available to it under any other provisions of the Agreement or otherwise at law.

NAME OF COMPANY:_____

NAME OF OFFICIAL:_____

TITLE: _____ DATE: _____

SIGNATURE: _____

EXHIBIT G-3

PROMPT PAYMENT CERTIFICATION

I make this certification on behalf of myself as a representative of the Contractor named below ("Contractor") and on behalf of the Contractor. I certify that for each application for payment submitted in connection with this Project: (1) the work covered by that application for payment has been completed in accordance with the Contract Documents; (2) the payment requested is due; and (3) all amounts have been paid by the Contractor for work for which previous payments were issued. No application for payment will be submitted without Contractor having paid all Subcontractors and suppliers their share of any funds received by Contractor pursuant to any previous application(s) for payment. I understand and acknowledge that this entire certification will be considered incorporated into every request for payment. I understand and acknowledge that if Contractor submits an application for payment without (1) having completed work in accordance with the contract documents, (2) payment requested being due, and/or (3) having paid all Subcontractors and suppliers their share of any funds received by Contractor pursuant to any previous application(s) for payment, then Contractor has submitted a false claim and false certification, subjecting Contractor to liability, damages and penalties under the New Jersey False Claims Act, N.J.S.A. 2A:32C-1 et seq.

If there is some legitimate reason the Contractor cannot timely pay a Subcontractor or supplier, then Contractor must submit a signed certification or affidavit to the owner/government entity fully explaining the situation, when the situation arose, and when it will be resolved. A failure to submit such an explanatory certification waives any defenses Contractor may later seek to assert in connection with liability under the New Jersey False Claims Act, N.J.S.A. 2A:32C-1 et seq. or any other law, including N.J.A.C. 7:1D et seq.

I further understand and acknowledge that a false certification, whether express or implied, that (1) the work covered by an application for payment has been completed in accordance with the contract documents, (2) the payment requested is due, and/or (3) all amounts have been paid by the Contractor to Subcontractors or suppliers for work for which previous payments were issued, is misleading with respect to the goods and services Contractor is providing.

I also understand and acknowledge that the requirements that (1) work has been completed in accordance with the contract documents, (2) the payment requested is due, and (3) all amounts have been paid by the Contractor for work for which previous payments were issued, are material to the State's decision to allocate State funding dollars for this contract, and also material to any local government entity's decision to retain and make payment to the Contractor. I understand and acknowledge that if owner/government entity makes payment knowing of such violations, that does not demonstrate that the requirements are not material, and does not constitute a waiver of liability under the New Jersey False Claims Act, N.J.S.A. 2A:32C-1 et seq. To the contrary, Contractor recognizes that owner/government entity may decide to continue to pay Contractor due to contractual and/or logistical requirements or considerations.

Additionally, I understand and acknowledge that a false certification, whether express or implied, that (1) the work covered by an application for payment has been completed in accordance

with the contract documents, (2) the payment requested is due, and/or (3) all amounts have been paid by the Contractor for work for which previous payments were issued, constitutes legitimate grounds for debarment pursuant to N.J.A.C. 7:1D et seq.

_____ _____

Signature Date

_____

Name and Title of Signer - Please Type

EXHIBIT G-4

PROJECT LABOR AGREEMENT
LETTER OF ASSENT

Re: Project Labor Agreement
The Union County Building & Trades Council, AFL-CIO and
_____
dated _____
(the "Agreement')

The undersigned, as a General Contractor and/or Project Management Firm, Contractor(s) or Subcontractor(s) on a Contract which is part of the Renovation & Addition of the Union College of Union County Physical Education Center, Cranford, NJ (the "Project"), for and in consideration of the award of a Contract to perform work on said Project, and in further consideration of the mutual promises made in the Project Labor Agreement, a copy of which was received and is acknowledged, hereby:

(1) On behalf of itself and all its employees, accepts and agrees to be bound by the terms and conditions of the Project Labor Agreement, together with any and all amendments and supplements now existing or which are later made thereto, and understands that any act of non-compliance with all such terms and conditions will subject the non-complying Contractor or employee(s) to being prohibited from the Project Site until full compliance is obtained.

(2) Certifies that it has no commitments or agreements that would preclude its full compliance with the terms and conditions of said Projects Labor Agreement.

(3) Agrees to secure from any Contractor(s) (as defined in said Project Labor Agreement) which is or becomes a Subcontractor(s) (of any tier), a duly executed Letter of Assent in form identical to this document prior to commencement of any work.

_____
Company Name

By: _____ Contract Number_____

Title: _____ General Contractor_____

Date: _____

cc: (Unions employed by Contractor)

EXHIBIT G-5

REQUEST FOR INFORMATION (RFI)

PROJECT: Renovation & Addition of the Union College of Union County Physical Education Center

RFI Number	Contractor	
Description: **NOTE _ AUTHOR SHALL PROVIDE REFERENCED DRAWING/ SPEC/ LOCATION**		
Referenced Doc; **Drawing - #** **Spec - #**	**Other;**	
Question :		
Issued By :		**Date**
Response :		
By: **Firm:**	**Date**	☐ ☐

Dist: **Name of A/E Contact**

Madelyn Pena
mpena@digrouparchitecture.com

Troy Marziotti
tmarzziotti@mastconstruction.com

Bibi Taylor
btaylorUCIA@ucnj.org

	Date	

EXHIBIT G-6

BYRD ANTI-LOBBYING AMENDMENT CERTIFICATION

The undersigned, [Bidder] _____ certifies, to the best of his or her knowledge, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

3. The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

The Contractor, [Company] _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. § 3801 et seq., apply to this certification and disclosure, if any.

Please check the appropriate box:

_____ No non-federal funds have been used or are planned to be used for lobbying in connection with this application/award/contract.

or

_____ Attached is Standard Form LLL, "Disclosure of Lobbying Activities," which describes the use (past or planned) of non-federal funds for lobbying in connection with this application/award/contract.

Executed this _____ day of _____, 20_____

By: _____ _____
(Type or Print Name) (Title of Executing Official)

_____ _____
(Signature of Executing Official) (Name of Company)

APPENDIX B

FORM OF AGREEMENT

AGREEMENT BETWEEN

UNION COUNTY IMPROVEMENT AUTHORITY

AND

CONTRACTOR

FOR

Renovation & Addition of Union College of Union County
Physical Education Center

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ATTACHMENT A - Special Conditions

ATTACHMENT B – Insurance Certificates and Business Registration Certificates

ATTACHMENT C – The Contractor's Employees, Subcontractors And Subconsultants

THIS AGREEMENT is made and entered into this ___ day of _____, 2025 (the "Effective Date") by and between the Union County Improvement Authority (the "Authority"), having an office located at 10 Elizabethtown Plaza, 5th Floor, Elizabeth, New Jersey 07207, and the (" "), a corporation with its principal place of business at [ ] (the "Authority" and "the Contractor" each a "Party", and the "Authority" and the " " collectively, the "Parties").

The Contractor, for and in consideration of the payments hereinafter specified and agreed to be made by the Authority, hereby covenants and agrees to perform all of the Work necessary to accomplish the Project identified as the construction of the Renovation & Addition of the Union College of Union County Physical Education Center in Cranford, NJ (the "Township"), in strict conformity with this Agreement, including all appendices and attachments hereto.

Provided that the Contractor performs all of the Work specified and all other obligations set forth in this Agreement, and subject only to such increases or decreases permitted by this Agreement, the Authority will pay the Contractor an amount as set forth in Section 9.1 of this Agreement.

IN WITNESS WHEREOF, the Parties have duly executed this Agreement.

[SIGNATURES ON THE FOLLOWING PAGE]

This Agreement has been reviewed and approved.

_____
(Name)
(Title)

UNION COUNTY IMPROVEMENT AUTHORITY

_____
Witness

By: _____
Bibi Taylor, Ed.D.
Title: Executive Director

[ ]

_____
Witness

By: _____
[ ]
Title: [ ]

Sworn to and subscribed
before me this _____ day
of _____, 202_.

_____
(Print Name), No.
State of New Jersey

My Commission expires
on _____.

1.0 DEFINITIONS

The terms set forth below shall have the meanings ascribed to them for all purposes of this Agreement, unless the context clearly indicates some other meaning. Words in the singular shall include the plural and words in the plural shall include the singular.

1.1 "Act" means the County Improvement Authorities Law, N.J.S.A. 40:37A-44 et. seq.

1.2 "AOC" means the Administrative Office of the Courts.

1.3 "Agreement" means this agreement, including all appendices, exhibits and all documents specifically incorporated herein, between the Authority and the Contractor, and any Change Order or Amendment issued after execution of this Agreement, as agreed to by the Parties.

1.4 "Amendment" means a written modification to this Agreement executed by the Authority and the Contractor.

1.5 "Authority" or "Union County Improvement Authority" means the public body corporate and politic of the State of New Jersey established pursuant to the County Improvements Authorities Law, N.J.S.A. 40:37A-44 et. seq.

1.6 "Authority having Jurisdiction" means any applicable local, State, national or Federal entities having jurisdiction over the Project.

1.7 "Architect" means the firm, including subconsultants, engaged by the Authority to provide architectural and other services, including oversight and reporting, in connection with the design and construction of the Project. The Architect is DiGroup Architecture.

1.8 "Architect Documents" means all documents prepared by the Architect setting forth the requirements and criteria for the design and construction of the Project and includes, but is not limited to, the technical information included within the Request for Bids and any Addenda thereto.

1.9 "Change Order" means a written order, directing or authorizing a change in the scope of the Work, executed by the Authority and the Contractor, and shall include adjustments, if any, to the Contract Price and extensions, if any, to the Contract Time.

1.10 "Claim" means a demand by the Contractor for (1) a time extension which is disputed by the Authority or (2) the payment of money or damages, arising from Work performed by or on behalf of the Contractor in connection with the Contract Documents, which is disputed by the Authority.

1.11 "Commencement Date" or "NTP Date" means the date set forth in the Notice to Proceed on which the Contractor is authorized to commence performing the Work pursuant to this Agreement and the Contract Documents.

1.12 “Compensation” means payment(s) due to the Contractor for Work performed pursuant to the Contract Documents.

1.13 “Construction Documents” means the plans, Project Specifications and other documents prepared by the Authority which set forth in detail the design for, and other necessary requirements relating to, the construction of the Project, based on the requirements set forth in the Contract Documents.

1.14 “Construction Manager” or “CM” means the person, persons or firm engaged by the Authority to act as the Authority’s representative on the Project, and to provide construction management services, including oversight and reporting services, in connection with the construction of this Project. The CM for the Project is MAST Construction Services, Inc.

1.15 “Construction Work” means the portion of the Work in which the Contractor constructs the Project in accordance with the terms of the Contract Documents.

1.16 “Contract Change Directive” or “CCD” means a written order by the Authority directing or authorizing some change to the Contract Documents for which change compensation and/or Contract Time extension, if appropriate, has not yet been determined. Upon agreement on Compensation and/or Contract Time extension, for a CCD, if any, a Change Order shall be issued resolving the CCD.

1.17 “Contract Documents” means this Agreement between the Authority and the Contractor governing the construction of the Project, the Contractor’s bid submission in response to the Request for Bids for this Contract, and all other documents setting forth the obligations of the Contractor with respect to the construction of the Project. The Contract Documents shall include the Architect Documents.

1.18 “Contract Milestones" mean the dates identified in the Project Schedule by which the Contractor must complete certain critical activities in advancement of the Project.

1.19 “Contract Price” means the total fixed amount established for the performance of the Work.

1.19 “Contract Time” means the number of calendar days identified in Appendix A within which the Contractor is required to complete the Work pursuant to this Agreement.

1.20 “Contractor” means [ ], who has been engaged by the Authority to construct the Project in accordance with the requirements of the Contract Documents. Any and all references to the term “Contractor” in the Contract Documents shall mean [ ] as such term is defined in this Agreement.

1.21 “Contractor’s Project Manager” means that person designated by the Contractor to serve as its representative for the Project and who shall have the non-exclusive authority to bind the Contractor in all matters relating to this Agreement.

1.22 "Day" means calendar day, unless otherwise specifically defined.

1.23 "DCA" means the New Jersey Department of Community Affairs.

1.24 "Deliverables" means any documents required to be produced by, or work product generated by the Contractor pursuant to the Contract Documents.

1.25 "Directive" means an order by the Authority directing the Contractor to perform Work under the Contract Documents. A Directive by the Authority requires the Contractor to perform the directed Work, even if there remains a dispute as to whether the Directive constitutes a Change in the Work or warrants additional Compensation.

1.26 "Document" means any written or graphic matter, however produced or reproduced, of any kind or description, including originals, marked copies and drafts, and including but not limited to, correspondence, letters, memoranda, notes, notations, transcripts, notes, books, pamphlets, or articles, requisitions, resolutions, certificates, opinions, reports, studies, analyses, evaluations, contracts, licenses, agreements, financial statements, ledgers, checks, books or records of accounts, statistical records, lists, tabulations, summaries, charts, graphs, maps, surveys, plans, drawings, specifications, schedules, sound recordings, photographs, computer disks, faxes and electronic mail, and papers and things similar to any of the foregoing.

1.27 "Effective Date" means the date on which this Agreement has been fully executed by the Parties, as indicated above.

1.28 "ELEC" means the New Jersey Election Law Enforcement Commission, the State entity established pursuant to N.J.S.A. 19:44A-5.

1.29 "Final Completion" means that point in time on the Project when the Project is 100% complete and (i) all requirements of the Contract Documents and the Architect Documents have been completed, (ii) all items on the Punchlist have been performed, and (iii) a Certificate of Occupancy, or a Certificate of Acceptance, as applicable, has been issued by the City of Elizabeth.

1.30 "Force Majeure Event" means an unforeseeable event beyond the control of the Contractor and the Authority that is not due to an act or omission of the Contractor (or any Subcontractor, Subconsultant or other person or entity for which the Contractor may be contractually or legally responsible) that materially and adversely affects the Contractor's obligations under this Agreement to the extent that such event (or the effects thereof) could not have been avoided or mitigated by due diligence and use of reasonable efforts by the Contractor . Force Majeure Events may include wars, floods, hurricanes, tornadoes, acts of terrorism, earthquakes, and other acts of God.

A "Force Majeure Event" under this Agreement shall also mean an event beyond the control of the Contractor and the Authority, that is not due to an act or omission of the Contractor (or any

Subcontractor, Subconsultant or other person or entity for which the Contractor may be contractually or legally responsible) and that event involves a declared pandemic by an Authority having Jurisdiction, that prevents or materially and adversely affects the Contractor's ability to perform its obligations under this Agreement and such impact could not have been avoided or mitigated by due diligence and use of reasonable efforts by the Contractor.

1.31 "Invoice" means a request for payment submitted by the Contractor to the Authority.

1.32 "Key Team Member" or "Contractor's Key Team Member" means individuals on the Contractor's Team, that have a responsible role in the successful completion of the Project and the performance under this Agreement. Key Team Members shall have the authority to bind the Contractor in all matters relating to this Agreement. Contractor to provide a list of Key Team Members at Project Kick off Meeting.

1.33 "Legal Requirements" means all applicable Federal, State and local laws, acts, statutes, ordinances, codes, executive orders, rules and regulations in effect or hereinafter promulgated, that apply to the Contractor's performance of Work under this Agreement, including, but not limited to, the current versions of the Building Design Services Act, the New Jersey Uniform Construction Code, the Occupational Safety and Health Act of 1970, the Soil, Erosion and Sediment Control Act, as well as any requirements of local or national Authorities having Jurisdiction over the Project, as applicable.

1.34 "Notice of Award" means a notice from the Authority to the Contractor that the Contractor's Bid has been accepted and that the Authority intends to enter into a contract with the Contractor for the Work set forth in the Request for Bids.

1.35 "Notice to Proceed" or "NTP" means a written notice from the Authority setting the Commencement Date on which the Contractor is authorized to commence performing Work pursuant to this Agreement.

1.36 "Parties" means the Authority and the Contractor.

1.37 "Prevailing Wage" means the prevailing wage rate required to be paid under this Contract pursuant to the New Jersey State Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq.

1.38 "Professional Services Consultants" means consultants hired by the Authority providing professional services associated with research, development, design, construction, construction administration, alteration, or improvement to real property, as well as incidental services that members of these professions and those in their employ may logically or justifiably perform. These consultants may provide services including, but not limited to, studies (including feasibility studies), investigations, surveys, evaluations, consultations, planning, programming, conceptual designs, plans and

specifications, cost estimates, construction management, inspections, submittal review, testing, preparation of operating and maintenance manuals, and other related services.

1.39 "Project" means the construction of the Renovation & Addition of the Union College of Union County Physical Education Center and the manufacture or supply of any personal property necessary for or ancillary to the Facility identified in Appendix A and required by this Agreement.

1.40 "Project Labor Agreement" means the Project Labor Agreement included as part of the Request for Bids for execution by the Contractor with respect to the terms and conditions of employment for the work to be performed under this Agreement.

1.41 "Project Specifications" means a written description prepared by the Authority as part of the Construction Documents setting forth the detailed technical and functional characteristics of, or the discrete design for, an item of material, equipment or Work to be incorporated into the Project, or a requirement of the Work to be performed under this Agreement. A Project Specification may include a statement of any of the Authority's requirements and may provide for inspection, testing or the preparation of a construction item before procurement.

1.42 "Punchlist" means the list of incomplete or defective Work, including Work that does not comply with the Architect Documents' applicable Code or Legal Requirements, to be performed or remedied by the Contractor. Punchlist(s) shall be prepared by the Contractor and submitted to the Architect, Authority and CM for approval prior to the issuance of the Certificate of Substantial Completion.

1.44 "Schedule" means the most current Critical Path Method ("CPM") schedule prepared and submitted by the Contractor to the Authority, wherein the Contractor identifies all critical, and certain non-critical, activities, Contract Milestones and the projected and actual time periods for completing such activities and Contract Milestones.

1.45 "Site" means the site for the Project as defined in the Architect Documents.

1.46 "State" means the State of New Jersey.

1.47 "Subconsultant" means the party to whom the Contractor or another subconsultant subcontracts part or all of the Work for which the Contractor or other subconsultant is ultimately responsible.

1.48 "Subcontractor" means the party to whom the Contractor or another subcontractor subcontracts part or all of the Work for which the Contractor or other subcontractor is ultimately responsible.

1.49 "Submittal" means documents or other tangible items prepared by the Contractor, including, but not limited to, shop drawings, product data mock-ups and samples. Submittals are subject to review by

the Architect for consistency with the Contract Documents and the Architect Documents, and by the Authority for consistency with such documents, as well as for functional and aesthetic sensibility.

1.50 "Substantial Completion" means that point in time on the Project when all of the following have occurred: (i) all essential requirements of the Contract Documents have been performed so that the purpose of the Contract Documents is accomplished; (ii) a Temporary Certificate of Occupancy has been issued by the City of Elizabeth ; (iii) the Punchlist has been created; (iv) the Contractor has delivered to the Authority the key(s) and/or code(s) for operation of the elevators; (v) there are no material omissions or technical defects or deficiencies, as identified by the Authority; and (vi) the Project is one-hundred percent (100%) ready for occupancy in accordance with its intended use.

1.51 "Substantial Completion Date" means the date by which the Contractor is required to achieve Substantial Completion as identified in Appendix A.

1.52 "Term" means the term of this Agreement as identified in Section 12.0 of this Agreement.

1.53 "Uniform Construction Code" or "Code" means the New Jersey Uniform Construction Code, as set forth in N.J.A.C. 5:23-1 et seq., and all applicable Subcodes, as such Codes are amended from time to time.

1.54 "Work" means all construction work performed by the Contractor and its Subcontractors and suppliers, including providing all material, equipment, tools and labor, necessary to complete the construction, as described in and reasonably inferable from the Construction Documents and the Contract Documents.

2.0 INTERPRETATION AND INTENT

2.1 Intent of Agreement. This Agreement is being entered into in accordance with and pursuant to the Redevelopment Law and the Act and is intended to set forth the obligations and responsibilities of the Parties with respect to completion of the Work required by the Contract Documents within the Contract Time and Contract Price. This Agreement, the Contract Documents are intended to be complementary and interpreted in harmony so as to avoid conflict, with words and phrases interpreted in a manner consistent with construction and design industry standards. Any services or work that may be reasonably inferred from the Contract Documents as being required to produce the intended result shall be supplied whether or not specifically called for. In the event of any inconsistency, conflict, or ambiguity between or among the terms of the Contract Documents, the documents shall take precedence in the order in which they are listed in Section 22.3 of this Agreement.

2.2 Review of Documents. The Contractor acknowledges that, prior to submitting its Bid on the Project, it reviewed all Documents relevant to the Project that have been prepared and furnished by the Authority, including but not limited to, the Contract Documents and any geotechnical reports or surveys

of the Site. If at any time during the Term of this Agreement, the Contractor requires information or documentation that has not been provided by the Authority, but is only available to the Authority, the Contractor must request such information from the Authority. Failure to request and review such information waives any Claim by the Contractor that such information was necessary to fulfill its obligations pursuant to the Contract Documents and/or this Agreement. The Contractor shall promptly notify the Authority of all errors, omissions, inconsistencies or other defects (including inaccuracies) which it may discover in the Contract Documents, and must provide written recommendations regarding changes or corrections to resolve any such error, omission, inconsistency or defect, and must obtain the Authority's approval before proceeding with the Work thereby affected by any such error, omission, inconsistency or defect. The Contractor shall not make a Claim premised upon any apparent error, omission, inconsistency or other defect in the Contract Documents unless the Contractor has first given notice to the Authority of the apparent error, omission, inconsistency or defect.

2.3 Review of Project Site and Conditions. The Contractor acknowledges that prior to submitting its Bid and in accordance with prudent and generally accepted engineering and construction practices, it undertook sufficient and appropriate activities to familiarize itself with the Project Site. The Contractor further acknowledges that it has examined regional climate conditions and other conditions relevant to the Project. As a result, the Contractor is deemed to be familiar with and accepts the physical requirements of the Work and conditions of the Project.

2.4 Approvals and Acceptances. In all cases where approvals, acceptances, consents or determinations are required to be provided hereunder, such approvals, acceptances or consents shall not be withheld unreasonably and such determinations shall be made reasonably, except in cases where a different standard (such as, by way of example only, sole discretion) is specified. In cases where sole discretion is specified for an approval, acceptance, consent, determination or other decision, the decision shall not be subject to dispute resolution hereunder.

3.0 GENERAL RESPONSIBILITIES OF THE CONTRACTOR

3.1 Scope of Work. The Contractor shall perform all Construction Work, and provide all material, equipment, tools and labor, necessary to complete the obligations described in and reasonably inferable from the Contract Documents within the time provided by the accepted Project Schedule.

3.2 Initial Meeting. The Authority will schedule a meeting between the Parties to be held within seven (7) Days after the Commencement Date to discuss issues affecting the administration of the Work and to implement the necessary procedures and deadlines, including those relating to Architect Documents, Submittals and payment, to facilitate the ability of the Parties to perform their obligations under this Agreement and the Contract Documents and to ensure a Project that is designed and constructed in a manner consistent with the Contract Documents and the Architect Documents.

3.3 Monthly Status Report. On or before the tenth day of the month, the Contractor shall provide the Authority, CM, and Architect with a monthly status report detailing the progress of its Work, including (i) the actual progress of the Work for the prior month according to the Schedule; (ii) discrepancies, conflicts, or ambiguities that exist in the Contract Documents that require resolution; (iii) health and safety issues that exist in connection with the Work; (iv) notice of potential Claims; and (v) other items that require resolution in order that the Contractor can complete the Work within the Contract Time.

3.4 Construction Project Management Software. The Contractor shall utilize the Construction Project Management Software provided by the Construction Manager for this Project.

3.5 Schedule. Within four (4) Days after the Commencement Date, the Contractor shall prepare and submit to the Authority, CM, and the Architect a Schedule for the execution of the Work in accordance with the Contract Time, for review and acceptance by the Authority. Within fourteen (14) Days after the initial meeting contemplated in Section 3.2 above, the Contractor shall submit to the Authority, CM, and Architect a Schedule, including design milestones, in CPM format. The Contractor is to provide to the Authority, CM, and Architect the working file and a PDF file, and shall indicate the dates for the start and completion of the various stages of the Work, including the dates when the Authority, CM, or Architect information or acceptances are required to enable the Contractor to achieve completion of the Work within the Contract Time. The Contractor shall include in the Schedule ample time for review of specific Deliverables by the AOC, the Juvenile Justice Commission, and any other Authority having Jurisdiction, including time for receipt of comments, time for any modification of documents by the Contractor to accommodate such comments, and time for subsequent review of any modifications to the Construction Documents.

3.5.1 The Authority shall review the proposed Schedule submitted by the Contractor per Section 3.5, along with any written comments and recommendations for acceptance or rejection of the Schedule provided by the CM and Architect. The Authority shall accept or reject the Schedule within seven (7) Days of receipt of the CM and Architect's comments and recommendations. Once accepted by the Authority, the Schedule shall be used by the Authority to monitor the Contractor's progress.

3.5.2 The Contractor shall submit to the Authority, CM, and Architect monthly Project Schedule updates, on or before the tenth day of each month. Such updates will be used by the Authority, CM and Architect to ensure the Contractor's compliance with the Project Schedule and progress in timely achieving Contract Milestones. In the event that the Project Schedule update indicates that the Contractor will not meet the Contract Milestones within the time set forth in the Project Schedule, the Contractor shall be required to prepare and submit a recovery Project Schedule to the Authority, CM, and Architect for review and acceptance by the Authority at no added cost to the Authority. Any necessary recovery to the Project will be the sole responsibility of the Contractor.

3.5.3 Any updates or revisions to the Project Schedule shall not relieve the Contractor of its obligations to complete the Work within the Contract Time, as such dates may be adjusted in accordance with this Agreement. Neither the Authority's review and acceptance of the Project Schedule, nor the CM and Architect's review and comment upon the Schedule (including any recommendations from the CM and Architect, if offered) shall be construed as relieving the Contractor of its complete and exclusive control over the means, methods, sequences and techniques for executing the Work.

3.5.4 The Contractor agrees that it will commence performance of the Work and direct an orderly progression of the Work to achieve Substantial Completion, including furnishing such employees, materials, facilities and equipment and working such hours, including extra shifts and overtime hours, as may be necessary to achieve such goal, all at the Contractor's own expense.

3.6 Government Approvals and Permits.

3.6.1 The Contractor shall obtain and pay for all permits, approvals, licenses, government charges and inspection fees required for the Project by any Authority having Jurisdiction over the Project, including but not limited to building permits, soils erosion permits, construction trailer permits, water permits, utility permits, and street opening permits.

3.6.2 To the extent that necessary permits, approvals, licenses, and the like require the payment of fees or submission of documents or drawings; provision of insurance certificates or other proofs of insurance; the addition of additional insureds under new or existing insurance policies; the indemnification of adjacent landowners, whether private or governmental, for encroachments or work upon their property; the revision of design documents; the performance of additional design, construction, or preparation work; or any other monetary or non-monetary conditions or requirements, the Contractor shall be responsible for fulfilling all such requirements, without additional cost to the Authority.

3.7 Standard of Care. The Contractor shall perform all construction Work efficiently, in a good and workmanlike manner and with the requisite expertise, skill, and competence to satisfy the requirements of the Contract Documents. The Contractor shall at all times exercise complete and exclusive control over the means, methods, sequences and techniques of construction.

3.8 Quality of Performance. All of the Contractor's Work shall be performed in accordance with the Standard of Care and quality described in Section 3.7. Should the Contractor, its Subcontractors or Subconsultants fail to exercise the applicable Standard of Care, the Contractor shall promptly provide, at no cost to the Authority, any additional construction Work necessary to correct any failure to comply with such Standard of Care, provided that the provision of such Work by the Contractor shall in no way limit or restrict the Authority's remedies, including the Authority's right to withhold payment for such performance and take such action that it deems appropriate until the Contractor has complied with such Standard of Care or has remedied such non-compliance to the satisfaction of the Authority, and provided

further that nothing in the foregoing shall be deemed to restrict or expand the Contractor's Standard of Care.

3.9 Errors, Omissions and Deficiencies. The Contractor agrees to perform the Work in a manner that will accomplish the intended purpose of the Contract Documents and the Architect Documents. The Contractor shall, without additional cost to the Authority, timely cure any errors, omissions, or other deficiencies in the Work caused by or in any way due to the actions or inactions of the Contractor. Any costs incurred by the Authority to correct any errors, omissions or deficiencies in the Contractor's Work caused by, or in any way due to, the actions or inactions of the Contractor may be deducted, at the Authority's sole discretion, from the payments then or thereafter due the Contractor. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Authority upon demand.

3.10 Liability for Defective Work and Materials. The Contractor shall be liable to the Authority for all damages caused by defects in the Work performed or materials provided by the Contractor. The Contractor shall indemnify and hold harmless the Authority, CM, and Architect for any and all costs incurred by the Authority, CM, and Architect as a result of such defective Work and materials, including, but not limited to, interest, attorney's fees and other expenses.

3.11 The Contractor's Project Manager. Prior to the execution of this Agreement, the Contractor shall designate a principal of its firm satisfactory to the Authority as the Contractor's Project Manager and that person shall be identified in Attachment A. the Contractor's Project Manager shall, so long as his/her performance is acceptable to the Authority, be responsible for the Contractor's Work through Final Completion of the Project, and shall represent the Contractor and be available for general consultation throughout the Project. the Contractor's Project Manager shall have authority to receive and transmit instructions and information and render decisions related to the Project on behalf of the Contractor, and shall have the non-exclusive authority to bind the Contractor in all decisions, changes or other matters relating to the Project. All directions given to the Contractor's Project Manager shall be binding as if given to the Contractor.

3.12 Construction Manager. The Authority has engaged a CM to assume certain of the Authority's day-to-day responsibilities for the Project and to act as the Authority's representative for the Project.

3.13 Radon Mitigation. the Contractor shall comply with radon mitigation construction techniques consistent with the Radon Hazard Subcode of the New Jersey Uniform Construction Code, N.J.A.C. 5:23-10 et seq. This requirement shall apply to all Projects, regardless of whether the project is located in a Tier 1 municipality, as defined in N.J.A.C. 5:23-10 (Appendix 10-A).

3.14 Utility Rebate and/or Incentive Programs. The Contractor shall construct the Project to maximize all discounts, rebates and/or reimbursements for the Project available under any applicable State, local or Federal utility rebate and/or reimbursement program. the Contractor shall provide the Authority with

assistance to meet the requirements of the most appropriate New Jersey Clean Energy Incentive Program such as P4P. The Contractor is responsible for all information that is needed for the satisfactory demonstration of compliance as mandated in the guidelines of said Program. The Contractor shall coordinate required activities and plan responsibilities for the Project.

3.15 Political Contributions ELEC Filing. The Contractor shall comply with its responsibility to file an annual disclosure statement on political contributions with ELEC pursuant to N.J.S.A. 19:44A-20.13 (P.L. 2005, c. 271, section 3), in the event it receives contracts in excess of $50,000 from a public entity in a calendar year. It is the Contractor's responsibility to determine if filing is necessary.

4.0 INTENTIONALLY OMITTED

5.0 THE CONTRACTOR'S CONSTRUCTION WORK

5.1 Requirements. The Contractor shall provide the necessary supervision, labor, inspection, start-up services, material, equipment, machinery, temporary utilities, temporary facilities all means and methods, scheduling and planning services to complete the Project in compliance with the Contract Documents.

5.2 Submittals. Submittals are all drawings, product data, material samples, mock-ups, calculations, and equipment, required to be submitted by the Contract Documents.

The Contractor shall provide the Authority with electronic copies of all Submittals in compliance with the Contract Documents.

5.3 Submittal Review Requirements. The Authority does not have the obligation, however, it has the right to review and comment on any and all Submittals (including Submittals under review). The Contract Documents will specify the Submittals that are to be provided to the Architect for review and acceptance. All interior and exterior finish materials are to be reviewed by the Architect for conformance with finish material samples provided with or referenced by Architect Documents.

5.4 Substitutions. A Substitution is a material, assembly, piece of equipment, or other item that deviates from the Contract Documents. If the Contractor elects to submit a substitution for a specified material, assembly or piece of equipment, the Contractor must submit a Substitution Request Form, confirming that the identified product meets the specifications and design intent of the Authority.

5.5 Non-compliant Submittals. If a Submittal is partially or wholly non-compliant with any requirements of the Contract Documents it is a Non-Compliant Submittal, in which case, the Contractor is obligated to identify on the Submittal each and every non-compliance with the Contract Documents. The Authority and the Architect are not responsible for the acceptance of any non-compliance that is not specifically identified in writing with the non-compliant submittal. At their own discretion, the Authority and the Architect may elect to adopt a Non-Compliant Submittal.

5.6 The Contractor's Representation. By providing Submittals, the Contractor represents that the Contractor has determined and verified all materials, field measurements, and field construction criteria related thereto and confirms that the information contained within such Submittals are in full compliance with the Contract Documents.

5.7 Authority and Architect's Review. The Authority's and the Architect's review is not undertaken to (1) determine the accuracy and completeness of each Submittal; (2) determine that any other details such as dimensions and quantities have been complied with; (3) substantiate instructions for installation and performance of equipment or systems designed by the Contractor; (4) approve safety precautions; or (5) approve construction means, methods, techniques, sequences, or procedures, all of which shall remain the Contractor's responsibility. The Authority's and Architect's review of specific items shall not indicate review, acceptance of an assembly or which the item is a component.

5.7.1 By providing the Architect with all Submittals, the Contractor represents that the Contractor has determined and verified all materials, field measurements and field construction criteria related thereto and has checked and coordinated the information contained within such Submittals with the requirements of the Contract Documents.

5.7.2 The Architect's review pursuant to this Section shall be solely for the purpose of determining whether the items or equipment specified in Submittals are consistent with the requirements of the Contract Documents, and is not to be deemed to be undertaken for any other purpose, including: (1) determining the accuracy and completeness of each Submittal; (2) determining that any other details such as dimensions and quantities have been complied with; (3) substantiating instructions for installation and performance of equipment or systems designed by the Contractor; (4) approving safety precautions; or (5) approving construction means, manners, methods, techniques, sequences or procedures, all of which shall remain the Contractor's responsibility. The Architect's review of specific items shall not indicate review, acceptance or approval of an assembly of which the item is a component. The Architect shall complete its review of the Contractor's Submittals within fifteen (15) Days.

5.7.3 Once the Architect has reviewed the Submittals, the Architect will provide the Submittals to the Authority for review and acceptance. The Authority shall review the Submittals and either accept or reject the submittals within four (4) Days of receipt thereof. The Authority's review pursuant to this Section shall not be deemed to be undertaken for the purpose of: (1) determining the accuracy and completeness of each Submittal; (2) determining that any other details such as dimensions and quantities have been complied with; (3) substantiating instructions for installation and performance of equipment or systems designed by the Contractor; (4) approving safety precautions; or 5) approving construction means, manners, methods, techniques, sequences or procedures, all of which shall remain the Contractor's responsibility. The Authority's review of specific items also shall not indicate review, acceptance or approval of an assembly of which the item is a component.

5.7.4 The Contractor acknowledges that the Authority may require the Contractor to make a reasonable number of changes to the Submittals prior to the Authority's acceptance of such Submittals.

5.8 Equipment and Materials. The Contractor warrants to the Authority that all materials and equipment furnished pursuant to the Contract Documents will be new, unless otherwise specified, and that all Work will be of good quality, free from faults, defects, and in conformance with the Contract Documents. All materials and equipment not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective and rejected by the Authority. If required by the Authority, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty shall be in addition to, and not in lieu of, any other warranty or guarantee provided for in this Agreement and/or by a manufacturer.

5.8.1 The Contractor shall furnish and deliver the necessary equipment and materials in ample quantities and as frequently as required to avoid delay in the progress of the Work and shall store them so as not to cause interference with the orderly progress of a Project. The Contractor shall have a representative at the Site to accept delivered equipment and materials, as such equipment and materials will not be accepted for delivery by the Authority.

5.8.2 Storage of materials is the responsibility of the Contractor. Materials shall be stored immediately on delivery in accordance with manufacturer's instructions to ensure the preservation of their quality and fitness. Stored materials, even if accepted before storage, may again be inspected by the CM and/or the Authority prior to their incorporation into the Project. Stored materials shall be located so as to facilitate their prompt inspection and maintenance.

5.8.3 Any materials or equipment susceptible to damage from the elements shall be stored in weather-tight enclosures. The Contractor shall maintain the temperature and humidity in the enclosed areas within the ranges stated in the manufacturer's instructions for the particular materials or equipment. The Contractor shall also store unpacked and loose products on shelves, in bins, or in neat groups of like items within the enclosed areas.

5.8.4 For exterior storage of materials or equipment, the Contractor shall provide substantial platforms, blocking or skids, to support materials and equipment above ground. The Contractor shall protect materials and equipment from soiling and staining and, for materials and equipment that are subject to discoloration or deterioration from exposure to the elements, the Contractor shall cover such equipment and materials with impervious sheet metal and provide ventilation to prevent condensation. The Contractor shall store granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials to prevent mixing with foreign matter. The Contractor shall provide surface drainage to prevent erosion and ponding of water in areas where materials and equipment are stored.

5.8.5 With the approval of the Authority, portions of a Project Site may be used for storage purposes and for the placing of the Contractor's plant and equipment, but additional space, if needed,

must be provided by the Contractor at its own expense. Private property shall not be used for storage purposes without written permission of the owner or lessee of such property. Copies of such written permission shall be furnished to the Authority prior to storage. Storage sites shall be restored to their original condition at no cost to the Authority.

5.8.6 Any materials or equipment intended for use on the Project stored off-Site by the Contractor shall be stored in a bonded and insured warehouse.

5.8.7 No materials, equipment, or supplies for use on the Project shall be subject to any lien or encumbrance or other agreement by which an interest is retained by the seller or any other person or entity. The Contractor warrants, by signing its Invoice, that it has free and sufficient title to all material, equipment and supplies used by it in the Work, free from all liens, claims or encumbrances.

5.9 Substitutes or "Or Equal" Items. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the naming of the item is intended to establish the type, function, and quality required. Unless the name is followed by words indicating that "no substitution is permitted," material and equipment of other suppliers may be accepted if written notice is provided by the Contractor to the Authority containing sufficient information to allow the Authority to determine that the material or equipment proposed is equivalent or equal to that named. Proposed substitutes will be compared against the criteria provided in the Contract Documents. The Authority will either accept or reject the proposed substitution within ten (10) Days of receipt of the Contractor's written notice of the proposed substitution. The Authority's acceptance of a substitute item does not release the Contractor from its responsibility under the terms of this Agreement to perform Work in conformity with the requirements of the Contract Documents.

5.10 Acceptance and Rejection of Materials, Equipment and Furnishings.

5.10.1 When specified by the Contract Documents, materials, equipment, assemblies, and furnishings will be accepted only if the Contractor provides the Authority with such materials, equipment, furnishings or assemblies that are fully compliant with all requirements. The Contractor's incorporation of any and all materials, equipment, furnishings or assemblies into the Work shall constitute the Contractor's acknowledgement that such materials, equipment, furnishings or assemblies are compliant with all applicable requirements.

5.10.2 All materials, equipment, assemblies and furnishings, whether in place or not, which do not comply with the requirements of the Contract Documents shall be considered unacceptable, and shall be rejected and removed immediately from the Project Site. Rejected materials, equipment, assemblies or furnishings, the defects of which have been corrected, shall not be used unless and until accepted by the Authority.

5.11 Use of Explosives.

5.11.1 When the use of explosives is necessary for the prosecution of the Work, the Contractor shall exercise the utmost care not to endanger life or property, including the Work. The Contractor shall be responsible for all permits, approvals, and damage resulting from the use of explosives.

5.11.2 The Contractor shall schedule a pre-blast meeting with the Office of Safety Compliance, Mine Safety and Explosives and the New Jersey Department of Labor. No blasting will be permitted prior to the pre-blast meeting.

5.11.3 Explosives on the Project Site shall be stored safely under lock and key. The storage places shall be expressly marked "DANGEROUS EXPLOSIVES". The storing and handling of explosives and highly inflammable materials shall conform to the regulations of DCA, the New Jersey Department of Labor and any local Authority having Jurisdiction over the Project. Proper means shall be used to avoid blasting damage to public and private property. All persons within the danger area shall be warned and given a reasonable time to withdraw.

5.11.4 Prior to the commencement of any blasting or use of explosives, the Contractor shall carefully document in the form of a Pre-Blast Survey, the existing condition in accordance with the local jurisdiction and NJ Turnpike Authority requirements, of all adjacent properties by taking a minimum of twelve (12) photographs of each adjacent property, including the structures thereon, and by documenting the condition of same in a video recording. The Contractor shall submit copies of such photographs in digital and hard-copy (8x10 glossy) format, and shall submit copies of the video in DVD format.

5.12 Cut-Overs. All cut-overs of mechanical and electrical services to existing buildings shall be approved, scheduled and coordinated in advance with the relevant municipal utility, and must be performed at a time convenient to the occupants and/or utility service providers so as not to unreasonably interfere with their operations.

5.13 Field Office and Temporary Facilities. the Contractor will provide an on-Site, suitable, separate, weather-tight, heated, insulated field office for use by the Authority's employees, Professional Services Consultants, and agents (including representatives of the CM) with vehicular parking. the Contractor shall also provide storage areas, staging areas, excavation borrow/spoils designated areas, commercial canteen areas, telephones, toilet facilities, and other temporary facilities which are necessary to perform the Work, as well as employee vehicular parking areas. The Contractor shall locate such areas to suit Project requirements, subject to approval of the Authority. The Contractor shall be responsible for maintaining and securing the necessary permits for such facilities.

5.14 Access, Roads and Walks.

5.14.1 The Contractor shall not obstruct any road or traffic area in the area of the Project. On the Project Site, the Contractor shall provide, place, grade and compact all necessary materials to maintain road and traffic areas in good condition and shall remove snow and debris as necessary to

provide and maintain in serviceable condition the access roadbed, as well as pedestrian ways. The Contractor shall keep adjacent streets free of any dirt and debris coming from the Site. The Contractor shall provide all sediment control protection as required by any applicable agency or authority having jurisdiction over the Project. The entire Project Site shall be fenced in with wind screens for dust control.

5.14.2 The Contractor shall obtain permission in writing from the appropriate property owners before using for construction purposes any existing driveways or parking areas outside of the boundaries of the Project Site. If permission is obtained, the Contractor shall maintain such driveways and areas in good condition during the construction period, and at Final Completion, shall restore them to the same condition as they were at the start of the Work.

5.14.3 The Contractor, its employees, Subcontractors, Subconsultants, suppliers and/or vendors shall not park trucks or other vehicles on any streets adjacent to the Project Site.

5.15 Building and Site Cleanup. In addition to the requirements set forth in Section 5.10, the Contractor shall keep the Building, Site and any surrounding streets and sidewalks reasonably free from debris, trash and construction waste to allow the Contractor to perform the Work efficiently, safely and without interfering with the use of adjacent land. the Contractor shall also be responsible for providing snow removal, grass maintenance and litter removal.

5.15.1 The Site must be cleaned daily. All work areas and adjoining roads and walkways used by the public, must be broom swept and all debris must be removed at the end of every shift or at appropriate intervals during the workday, to the satisfaction of the CM and Authority, to ensure safety and proper housekeeping to minimize risk of injury, fire, or other impacts to worker or public safety.

5.15.2 If the Contractor fails to properly and completely clean up after each shift, the next scheduled shift may be utilized by the CM (or the Authority) to complete cleaning prior to the Contractor being allowed to proceed with any contract scopes of work. The Contractor is to provide full time dedicated labor forces to provide ongoing cleaning services. Failure to so provide will result in lost time at no additional cost to the Authority. In the event the Authority is required to retain outside cleaning services to perform the obligations of the Contractor under this Section, the Contractor will be back-charged for the full cost of such services plus the cost of supervision by the CM or Authority, if applicable.

5.15.3 Upon Substantial Completion of the Work, or a portion of the Work, the Contractor shall remove all debris, trash, construction waste, materials, equipment, machinery and tools to permit the Authority to occupy the Project, or a portion of the Project, for its intended use.

5.16 Winter Protection. The Contractor shall provide winter protection to the Project, including, but not limited to, providing temporary heat to maintain the Project buildings at a temperature of at least

forty (40) degrees Fahrenheit or greater, as may be required for the construction activity, at no added cost to the Authority.

5.17 Camera System. The Contractor is to provide a site camera system featuring two (2) 18.0 megapixel digital SLR cameras and a dependable Linux computer system. The cameras are to be all-weather cameras which automatically capture snapshots on a schedule and installed to provide opposing views. A cellular modem (Verizon, Sprint, AT&T, or Global/SIM card) is to be built into the camera system to transmit (via FTP) live images from the jobsite over the internet to the computer of the Contractor.

I. The Contractor shall provide a High Definition Megapixel Web Camera which shall provide a full view of the work area on the construction jobsite. The Web Camera shall allow users to remotely view the project on a secure connection via a network connection.

Basis of Design: Work Zone Cam or equal.

II. The Web Camera shall meet or exceed the following requirements:

a. Thermostatically controlled enclosure with heater and blower

b. Powder coated aluminum housing with stainless steel fittings for padlocks

c. Canon digital SLR camera with 18 Megapixel images (5184 x 3456 pixels), APS-C imager

d. Angle of view: wide 63° horizontal – 44° vertical, full zoom 22° horizontal - 15° vertical

e. Auto Features: ISO speed, metering mode, white balance, and focus

f. EF-S 18mm-55mm f/3.5-5.6 Image Stabilization STM lens

g. Professional photo grade lens window

h. Omni-directional power indicator lamp will illuminate green

i. Two UL rated compression glands, gas spring lid, adjustable camera sled

j. Compression: JPEG/RAW

k. 4GB onboard storage

l. 12VDC Solar Power

m. Communications 10base-T/100base-TX Ethernet, IP Addressing: Dynamic or Static

n. Wireless cellular modem EVDO REV.A full duplex transceiver with GPS and exterior outdoor antenna

III. Online Web Interface: The Web Camera will function via a web-based interface to allow the viewing of all High Definition still images captured and stored from any location with internet access.

The Online Web Interface shall include:

a. Company logo and project name

b. Multiple tabs option for accessing multiple cameras from one page

c. Digital Pan, Tilt, and Zoom capability within a High Definition image

d. Easy navigation with intuitive image calendar control

e. Automated image geotagging with camera location

f. Downloadable up-to-date high-quality time-lapse movies with embed code for adding the time-lapse to websites

g. Image Comparison Tool for overlaying two images from different dates and times for comparison

h. Share Image Tool for saving and emailing

i. Local weather data

j. Map integration of GPS data showing camera location

k. Multiple website themes with option to personalize background

l. Administrative controls for the client, allowing them to customize public access page, including project name, camera name configuration and username management with three levels of password protection.

IV. The system shall capture and upload images every 30 minutes, 24 hours per day.

V. The system vendor will maintain images on their servers for reference available to the Authority, CM and Architect, at all times during the life of the project. All images will be protected on secure fully redundant servers at multiple locations owned and operated by the system vendor.

VI. The system vendor shall provide an embed code or web interface link with [ ]'s Project details for unlimited public or private access.

VII. The Contractor shall secure a nearby structure for camera mounting or provide a fixed pole (40 feet/12 meters height recommended and 3 inches/8centimeters minimum diameter) as per the system vendor's instruction. The Contractor shall supply all equipment required for safe and secure access to the camera location, including building access, bucket truck and/or lift, for technicians performing installation and maintenance services.

5.18 Repair of Finished Surfaces, Applied Finishes, Other Materials.

5.18.1 Before Final Completion of the Project, the Contractor shall replace all broken, scratched or otherwise damaged glass or other materials installed by it or its Subcontractors on the Project regardless of the cause of the breakage or damage.

5.18.2 The Contractor shall clean all glass and other materials on the Project upon Final Completion, or when directed, removing all paint spots, stains, plaster, or other foreign material.

5.18.3 The Contractor accepts sole responsibility for the repair of cracking, delaminating, peeling or dislodging of finished surfaces such as concrete, pre-cast concrete, cast and natural stone, unit masonry, millwork, plaster, glass and applied finishes such as paint, and special coatings within the limits of specified warranty periods, regardless of the cause.

5.19 As-Built Drawings. The Contractor shall provide As-Built Drawings in accordance with 017839 Project Record Documents.

5.20 Project Closeout. The Contractor shall provide Project Close-Out in accordance with 017700 Closeout Procedures.

6.0 PROSECUTION AND PROGRESS OF THE SERVICES AND WORK

6.1 Performance of Work. Appendix A to this Agreement includes the names and titles of all key employees, Subcontractors and Subconsultants retained by the Contractor to perform Work for the Project. Throughout the Term of the Project, the Contractor shall update the list of employees, Subcontractors, and Subconsultants every six (6) months or within five (5) Days after the Contractor replaces any employees, Subcontractors or Subconsultants on the Project.

6.2 Key Team Members.

6.2.1 The Contractor shall utilize the Key Team Members identified in Attachment A.

6.2.2 Replacement of Key Team Members. The Contractor shall provide written notice to the Authority in the event that the Contractor proposes to replace, add or remove any Key Team Member. No changes in Key Team Members shall be permitted without the prior, written approval of the Authority. Any proposed replacement or new Key Team Member must have equal or superior

qualifications to the Key Team Member that the Contractor proposes to replace. The Contractor shall submit to the Authority, for approval, the name and qualifications of proposed Key Team Member substitutions.

6.2.3 Changes to Key Team Members Requested by the Authority. The Authority may, at its sole option, review from time to time the Contractor's Key Team Members. If, in the Authority's sole opinion, changes to Key Team Members are necessary, the Authority shall notify the Contractor in writing. Upon receipt of said notice, the Contractor shall submit to the Authority, for approval, the name and qualifications of proposed Key Team Member substitutions. No changes to Key Team Members shall be permitted without the prior, written approval of the Authority.

6.3 Subcontractors and Subconsultants. In the event the Contractor hires, employs or otherwise engages Subcontractors or Subconsultants, the Contractor shall be considered the sole point of contact with regard to matters relating to this Agreement. The Contractor assumes sole and full responsibility for the complete performance contemplated by this Agreement, including the performance of all of its Subcontractors and Subconsultants.

6.3.1 Approval by the Authority. The Contractor must: (i) select only Subcontractors and Subconsultants that have been pre-qualified by the DPMC, and (ii) obtain consent of the Authority prior to engagement of any such Subcontractors or Subconsultants. The Contractor is not required to obtain the Authority's consent prior to the engagement of vendors or suppliers.

6.3.1.1 The Contractor will not be permitted to subcontract to firms or individuals suspended or debarred by the State of New Jersey, or to firms or individuals that are otherwise ineligible to perform as Subcontractors or Subconsultants on the Project pursuant to regulation, Authority procedures or the requirements of the Contract Documents.

6.3.1.2 The Contractor shall list in its Bid all Subcontractors or Subconsultants required by the Contract Documents to be included therein.

6.3.1.3 As soon as a potential additional Subcontractor or Subconsultant has been identified by the Contractor, but in no event less than twenty (20) Days prior to the scheduled commencement of Work by such Subcontractor or Subconsultant, the Contractor shall notify the Authority in writing of the name and address of the Subcontractor or Subconsultant and shall request that the Authority approve the Subcontractor or Subconsultant. Within ten (14) Days after receipt of such request, the Authority will notify the Contractor whether the Subcontractor or Subconsultant has been approved, or will advise the Contractor of the reasons for the Authority's disapproval of the Subcontractor or Subconsultant, or need for further investigation into the Subcontractor or Subconsultant's application representations. If a proposed Subcontractor or Subconsultant is disapproved, the Contractor shall submit other candidates for approval.

6.3.1.4 The Authority shall not be liable for any costs, damages or delays incurred by the Contractor resulting from the Authority's disapproval of a Subcontractor or Subconsultant, nor shall the Contractor be entitled to any reimbursement or time extensions in connection with such disapproval.

6.3.2 Responsibility for Subcontractors and Subconsultants. It is expressly understood by the Contractor that the consent of the Authority to the subcontracting of any Work under this Agreement shall not relieve the Contractor from performing its obligations under the Contract Documents. The Contractor shall at all times give due attention to the fulfillment of its obligations under the Contract Documents and shall keep all Work under its control. Consent by the Authority to any subcontracting of any part of the Work shall not be construed to be an approval of said subcontract or of any of its terms, but shall operate only as consent to the engagement by the Contractor of Subcontractors and/or Subconsultants. The Contractor shall coordinate the activities of all Subcontractors and Subconsultants. the Contractor shall be responsible for all Work performed by its Subcontractors and/or Subconsultants.

6.3.3 Performance of Work by Subconsultants, Subcontractors and Suppliers. The Contractor assumes sole responsibility to the Authority for proper performance of the Work by Subconsultants, Subcontractors and entities supplying materials or equipment to the Contractor or its Subcontractors and Subconsultants, and any acts and omissions in connection with such performance. Nothing in the Contract Documents is intended or deemed to create any legal or contractual relationship between the Authority and any Subcontractor, Subconsultant or supplier of materials or equipment, including but not limited to any third-party beneficiary rights.

6.4 Cooperation. The Contractor shall cooperate with any other Professional Services Consultants and contractors, engaged by the Authority for this Project. The Authority will identify in Appendix A such Professional Services Consultants and/or contractors and their roles by the Effective Date of this Agreement or by other means if such Professional Services Consultants and/or contractors are engaged during the Term.

6.5 Records. For all Work performed, the Contractor shall, in accordance with generally accepted accounting principles and practices, maintain weekly certified payroll, workers' compensation payroll, overhead, cost and accounting records, as well as all other records that the Contractor may customarily maintain in its business. Such records shall be maintained and made available for inspection by the Authority, any other State oversight or inspecting agency. Before Final Payment will be made to the Contractor, the Contractor must provide all such records to the Authority.

6.6 Quality Assurance/Quality Control ("QA/QC"). The Contractor shall have full responsibility for quality assurance and quality control throughout all phases of the Project. The Contractor shall prepare and submit to the CM a detailed written Quality Assurance/Quality Control (QA/QC) Program. The CM shall review the Contractor's QA/QC Program and recommend acceptance or rejection of the

Program to the Authority within ten (10) Days of receipt of the Contractor's QA/QC Program. The Authority will either accept or reject the Contractor's QA/QC Program within five (5) Days of the CM's recommendation to the Authority. If the Authority rejects the Contractor's QA/QC Program, the Contractor shall revise and resubmit the QA/QC Program to the Authority until it is accepted. Once the QA/QC Program is accepted, the Authority shall monitor the Contractor's compliance with the Program to ensure that the Work are performed to meet or exceed the requirements of the accepted QA/QC Program. As part of the Contractor's QA/QC Program, the Contractor shall designate one (1) full-time employee whose sole responsibility will be to maintain and monitor the Contractor's compliance with its QA/QC Program. If the Contractor's Work fail to meet the accepted QA/QC Program, the Authority will implement a course of action to address the Contractor's failure to comply with the QA/QC Program. The Authority's actions to verify the Contractor's compliance with the QA/QC Program shall not relieve the Contractor of its obligation to establish a QA/QC Program, comply with the QA/QC Program or meet the requirements of the Contract Documents. The Contractor's failure to comply with the requirements of this Section 6.6 shall be deemed an Event of Default under this Agreement. Such Event of Default may trigger Default remedies as stated in Section 18.0.

6.7 Safety Plan. The Contractor shall be responsible for preparing a Safety Plan for the Project which recognizes the importance of performing the Services and Work in a safe manner so as to prevent damage, injury or loss to (i) all individuals at the Site, whether working or visiting, (ii) the Work, including materials and equipment incorporated into the Work or stored on-Site or off-Site, and (iii) all other property and individuals at the Site or adjacent thereto. The CM and/or the Authority's safety division shall review the Contractor's Safety Plan for consistency with the Authority's requirements and policies, and all other applicable Legal Requirements, including, but not limited to, governmental safety codes, rules, regulations and requirements, such as OSHA. This review shall not create any duty or responsibility on the part of the Authority's representative, their employees, or any other third-party regarding jobsite safety, temporary bracing, shoring, scaffolding, or partially completed construction. Responsibility for safety and for construction means, methods, techniques, sequences, and procedures and all such areas shall remain solely with the Contractor performing the Work.

Within ten (10) Days of receipt of the Contractor's Safety Plan, the CM and/or the Authority's safety division shall recommend to the Authority acceptance or rejection of the Contractor's Safety Plan. The Authority will either accept or reject the Safety Plan within five (5) Days of the CM's and/or the Authority's safety division's recommendations. The Contractor shall continue to submit its Safety Plan to the CM and/or the Authority's safety division until it is accepted. The Contractor is responsible to adhere to its approved Safety Plan. The Contractor is fully responsible to provide a safe working environment. The Contractor is responsible for the care, custody and control of the Project Site at all times.

6.8 Security Plan. The Contractor shall be responsible for preparing and submitting a Security Plan to the CM. Within ten (10) Days of receipt of the Contractor's Security Plan, the CM shall review and

recommend to the Authority acceptance or rejection of the Contractor's Security Plan. The Authority will either accept or reject the Contractor's Security Plan within five (5) Days of receipt of the CM's recommendation to the Authority. If the Contractor's Security Plan is rejected, the Contractor shall revise and resubmit its Security Plan to the CM until it is accepted. Once the Contractor's Security Plan is accepted, the CM shall monitor the Contractor's compliance with the Security Plan to ensure that the Contractor meets or exceeds the accepted Security Plan. At a minimum, the Contractor's Security Plan shall require the Contractor to provide all locks, doors and security necessary to secure the Facility until Final Completion. In addition, the Contractor shall be responsible for the security of any stored materials and/or temporary structures that it has located on the Project Site or elsewhere. the Contractor shall also provide all Site fencing, gates, security personnel, security services, and security structures and equipment required by the Contract Documents, or otherwise necessary to properly protect the Site and the Work. the Contractor is fully responsible for providing a secure Site. The Contractor is also responsible for the care, custody and control of the Project Site at all times.

6.9 Progress Reports. The Contractor shall keep the Authority informed of the progress and quality of the Work. On a monthly basis, or otherwise as agreed by the Authority and the Contractor, the Contractor shall submit written progress reports to the Authority, the CM, and Architect, showing estimated percentages of completion and other information identified below:

1. Work completed for the period;
2. Project schedule status;
3. Submittal schedule and status report, including a summary of outstanding Submittals;
4. Responses to requests for information to be provided by the Owner;
5. Approved Change Orders and Change Directives;
6. Pending Change Order and Change Directive status reports;
7. Tests and inspection reports;
8. Status report of Work rejected by the Owner;
9. Status of Claims previously submitted in accordance with Article 14;
10. Cumulative total of the Cost of the Work to date including the Contractor's compensation and Reimbursable Expenses, if any;
11. Current Project cash-flow and forecast reports;
12. Any required updates; and
13. Additional information as agreed to by the Owner and the Contractor.

In addition, the Contractor shall include the following additional information in its progress reports:

1. The Contractor's work force report;
2. Equipment utilization report; and
3. Cost summary, comparing actual costs to updated cost estimates.

7.0 INSPECTION OF THE WORK AND CORRECTION OF NON-CONFORMING WORK

7.1 Inspection of the Work. Each part or detail of the Work performed by the Contractor is subject to inspection by the City of Cranford, the CM, the Architect, the Authority or its representatives and a third-party inspector retained by the Authority, at the cost of the Authority. The Authority, the CM, the Architect, the City of Cranford, and the Authority's third-party inspector, shall be allowed access to all parts of the Work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection. When the Authority, the CM, the Architect, and the Authority's third-party inspector are on the Project Site in the course of their employment, they shall be deemed conclusively to be invitees of the Contractor.

7.1.1 The Contractor shall not cover any Work that has not been inspected or approved.

7.1.2 The Authority may order any Work done without the required inspection to be removed and replaced. The Contractor will be responsible for the costs of uncovering, removing, and/or replacing the uninspected Work.

7.2 Correction of Non-Conforming Work.

7.2.1 Repair and Replacement. In the event that the Authority finds that any of the Work performed or any of the materials furnished or equipment supplied, or any of the finished Work in which such materials are used or such equipment is installed, are not in strict conformity with the requirements of the Contract Documents, the Work, materials and/or equipment shall be removed and replaced or otherwise be brought into strict compliance with the requirements of the Contract Documents by and at the sole cost and expense of the Contractor.

7.2.2 Correction of Nonconforming Work. The Authority shall require timely correction by the Contractor of nonconforming Work. If nonconforming Work remains uncorrected for more than thirty (30) Days from the Contractor's receipt of notice of the nonconforming Work from the Authority, the CM or the Architect, the Contractor's next Invoice shall be reduced by an amount equivalent to the entire value of the nonconforming Work, as if the nonconforming Work was 0% complete. The CM shall maintain a continuing list of nonconforming Work as determined by the CM, the Authority or the Architect, and shall distribute this list to the Contractor periodically. If the Contractor fails to correct any nonconforming Work in accordance with this Section, the Authority shall take all steps to remedy the Contractor's failure. In such case, an appropriate written notice shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such failure. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Authority upon demand.

8.0 CHANGES TO THE SCOPE OF SERVICES AND WORK

8.1 Change Orders.

8.1.1 A Change Order may be executed by the Contractor and the Authority for the purpose of: (a) modifying the scope of the Work; (b) revising the Contract Time; (c) making adjustments to the Contract Price to reflect changes in the scope of the Work; or (d) revising other terms and conditions of the Contract Documents.

8.1.2 All changes to the scope of the Work authorized by Change Order shall be performed pursuant to the terms of a Change Order, including, but not limited to, any drawings or Specifications provided as part of the Change Order.

8.1.3 The Authority may direct the Contractor to perform Work required by the Contract Documents. Such Directives from the Authority do not constitute a change to the scope of the Work and will not result in an increase in the Contract Price or an adjustment to the Contract Time. the Contractor shall perform the Work described in the Directive, even if the Contractor disputes that such Work are required by the Contract Documents.

8.2 Changes in Scope Warranting an Adjustment to the Contract Price.

8.2.1 The Contract Price shall not be increased unless there is a change in the Contractor's scope of Work.

8.2.2 The increase or decrease in the Contract Price resulting from a change in the scope of the Work shall be determined by one or more of the following methods:

(a) Unit prices agreed to between the Parties;

(b) A lump sum submitted by the Contractor, properly itemized and supported by sufficient substantiating data to permit a thorough evaluation by the Authority;

(c) Costs, fees and any other markups set forth in the Agreement; or

(d) If the Parties cannot agree to the adjustment to the Contract Price, the cost of the change shall be determined by the reasonable direct costs in performing the Work resulting from the change, including a markup of 15% for reasonable overhead and profit. If the net result of both additions and deletions is a decrease to the Contract Price, there shall be no overhead or profit adjustment to the Contract Price. The Contractor shall maintain a documented, itemized accounting evidencing the expenses and savings associated with such changes.

8.2.3 If the Authority and the Contractor disagree upon whether the Contractor is entitled to an adjustment to the Contract Price for any Work required by the Authority, or if there are any other disagreements over the scope of Work or proposed changes to the scope of Work, the Authority and the Contractor shall resolve the disagreement pursuant to Section 19.0 of this Agreement. If the Parties are unable to agree and the Authority directs the Contractor to perform the Work in accordance with the Authority's interpretations, the Contractor shall perform the disputed Work upon issuance by the Authority of a Contract Change Directive ("CCD") to the Contractor (i) directing the Contractor to proceed with the Work in dispute, and (ii) specifying the Authority's interpretation of the Work that are to be performed. If a CCD is issued, the Contractor shall proceed with the Work while pricing and negotiating the same, unless otherwise directed by the Authority. Upon issuance of a CCD, the Contractor shall be entitled to submit an Invoice for the CCD Work actually performed during the prior month in an amount up to the Authority's reasonable estimated direct costs to perform the Work. The Authority agrees to pay such amounts, with the express understanding that: (i) such payment by the Authority does not prejudice the Authority's right to assert that it has no responsibility to pay for such Work; (ii) the Contractor shall complete one-hundred (100%) of the Work required by the CCD; and (iii) receipt of such payment by the Contractor does not prejudice the Contractor's right to seek full payment of the disputed Work if the Authority's CCD is deemed to be a change in the scope of the Work.

8.3 Force Majeure and Other Changes Warranting an Adjustment in the Contract Time.

8.3.1 If the Contractor is delayed in the performance of the Work due to a Force Majeure Event, the Contract Time for performance shall be reasonably extended by Change Order as set forth in Section 8.1.

8.3.2 In addition to the Contractor's right to a time extension for Force Majeure Events, the Contractor may be entitled to an appropriate adjustment to the Contract Price if the Force Majeure Event causes a change to the scope of Work.

8.3.3 The Authority will also consider and, in its discretion, grant requests for adjustments to the Contract Price or extensions of the Project Schedule due to a delay the cause of which is beyond the control of the Contractor.

8.3.4 No request for compensation or extension will be considered by the Authority unless the Contractor: (i) delivers to the CM and the Authority Project Manager a written notice of delay within five (5) Days of an event causing a delay or expected to cause a delay; and (ii) delivers to the Authority a written request for extension of the Project Schedule and/or compensation within fourteen (14) Days following the conclusion of the delay for which an extension is sought.

8.3.5 The Contractor's failure to comply with the written notice requirements set forth in Section 8.3.4 waives any right to an extension of time or compensation for delay from the Authority.

8.3.6 Irrespective of whether the Contractor makes a request for an extension of time or compensation for delay pursuant to this Section, the Contractor shall notify the Authority of any event of which it is aware that may cause any delay in the completion of the Project.

8.4 Differing Site Conditions – N.J.S.A 40A:11-6.7.

8.4.1 Differing Site Conditions. If the Contractor encounters Differing Site Conditions during the progress of the Work, the Contractor shall promptly notify the Authority in writing of the specific Differing Site Conditions encountered before the Site is further disturbed and before any additional Work is performed in the impacted area. Upon receipt of a Notice of Differing Site Conditions or upon the Authority otherwise learning of Differing Site Conditions, the Authority shall promptly undertake an investigation to determine whether Differing Site Conditions are present. If the Authority determines Different Site Conditions that may result in additional costs or delays exist, the Authority shall provide prompt written notice to the Contractor containing directions on how to proceed.
The Authority shall make a fair and equitable adjustment to the Contract Price and Contract Time for increased costs and delays resulting from the agreed upon Differing Site Conditions encountered by the Contractor. If both Parties agree that the Authority's investigation and directions decrease the Contractor's costs or time of performance, the Authority shall be entitled to a fair and equitable downward adjustment of the Contract Price or Contract Time.

If the Authority determines that there are no Differing Site Conditions present that would result in additional costs or delays, the Authority shall so advise the Contractor, in writing, and the Contractor shall resume performance of the Contract, and shall be entitled to pursue a Differing Site Conditions claim against the Authority for additional compensation or time attributable to the alleged Differing Site Conditions.

Execution of the Contract by the Contractor shall constitute a representation that the Contractor has visited the Site and has become generally familiar with the local conditions under which the Work is to be performed.

As used in this subsection, "Differing Site Conditions" mean physical conditions at the Site that are subsurface or otherwise concealed and which differ materially from those indicated in the Contract Documents or are of such an unusual nature that the conditions differ materially from those ordinarily encountered and generally recognized as inherent in the Work of the character provided for in the Contract.

The Authority shall provide written notice to the Contractor in advance of any suspension of work lasting more than ten (10) calendar days of the performance of all or any portion of the Work of the Contract. If the performance of all or any portion of the Work is suspended by the Authority for more than ten (10) calendar days due to no fault of the Contractor or as a consequence of an occurrence beyond the Authority's control, the Contractor shall be entitled to compensation for any resultant delay to the Project completion or additional expenses, and to an extension of time, provided that, to the extent feasible, the Contractor, within ten (10) calendar days following the conclusion of the suspension, notifies the Authority in writing, of the nature and extent of the suspension of Work. The notice shall

include available supporting information, which information may thereafter be supplemented by the Contractor as needed and as may be reasonably requested by the Authority. Whenever a work suspension exceeds sixty (60) days, upon seven (7) days' written notice, either party shall have the option to terminate the Contract for cause and to be fairly and equitably compensated therefor.

Upon receipt of the Contractor's suspension of Work notice, the Authority shall promptly evaluate the Contractor's notice and promptly advise the Contractor of its determination on how to proceed in writing. If the Authority determines that the Contractor is entitled to additional compensation or time, the Authority shall make a fair and equitable upward adjustment to the Contract Price and Contract completion date. If the Authority determines that the Contractor is not entitled to additional compensation or time, the Contractor shall proceed with the performance of the Work and shall be entitled to pursue a suspension of Work claim against the Authority for additional compensation or time attributable to the suspension. Failure of the Contractor to provide timely notice of a suspension of Work shall result in a waiver of a claim if the Authority can prove by clear and convincing evidence that the lack of notice or delayed notice by the Contractor actually prejudiced the Authority's ability to adequately investigate and defend against the claim.

If the Contractor believes that a change directive by the Authority results in a material change to the Work, the Contractor shall so notify the Authority in writing. The Contractor shall continue to perform all Work on the Project that is not the subject of the notice. Upon receipt of the Contractor's change in character notice, the Authority shall promptly evaluate the Contractor's notice and promptly advise the Contractor of its determination on how to proceed in writing.

If the Authority determines that a change to the Contractor's work caused or directed by the Authority materially changes the character of any aspect of the Work, the Authority shall make a fair and equitable upward adjustment to the Contract Price and Contract completion date. The basis for any such price adjustment shall be the difference between the cost of performance of the Work as planned at the time of contracting and the actual cost of such Work as a result of its change in character, or as otherwise mutually agreed upon by the Parties prior to the Contractor performing the subject Work.

If the Authority determines that the Contractor is not entitled to additional compensation or time, the Contractor shall continue the performance of all Work and shall be entitled to pursue a claim against the Authority for additional compensation or time attributable to the alleged material change.

As used in this section, "material change" means a character change which increases or decreases the Contractor's cost of performing the Work, increases or decreases the amount of time by which the Contractor completes the Work in relation to the contractually required completion date, or both.

The Authority may increase or decrease the quantity of Work to be performed by the Contractor. If the quantity of a pay item is cumulatively increased or decreased by 20 percent or less from the price proposal quantity, the quantity change shall be considered a minor change in quantity. If the quantity of a pay item is increased or decreased by more than 20 percent from the price proposal quantity, the quantity change shall be considered a major change in quantity. For any minor change in quantity, the Authority shall make payment for the quantity of the pay item performed at the price proposal for the

pay item.

For a major increase in quantity, the Authority or the Contractor may request to renegotiate the price for the quantity in excess of 120 percent of the price proposal quantity. If a mutual agreement cannot be reached on a negotiated price for a major quantity increase, the Authority shall pay the actual costs plus an additional 10 percent for overhead and an additional 10 percent for profit, unless otherwise specified in the original price proposal.

For a major decrease in quantity, the Authority or the Contractor may request to renegotiate the price for the quantity of Work performed. If a mutual agreement cannot be reached on a negotiated price for a major quantity decrease, the Authority shall pay the actual costs plus an additional 10 percent for overhead and an additional 10 percent for profit, unless otherwise specified in the original price proposal; provided, however, that the Authority shall not make a payment in an amount that exceeds 80 percent of the value of the price proposal multiplied by the price proposal quantity.

As used in this section, the term "price proposal quantity" means the quantity indicated in the Contractor's price proposal less the quantities designated in the Project plans as "if and where directed."

8.4.2 Contaminated or Hazardous Materials. Should the Contractor discover previously undetected asbestos, contaminated soils, radon, lead, PCBs or other hazardous or contaminated material, the Contractor shall report its findings immediately to the Authority. During any remedial action undertaken by the Authority or any other Party, the Contractor may be required to cease Work on the Project, if so directed by the Authority. If the Contractor is required to cease performance of Work due to the discovery of hazardous or contaminated materials, such Work stoppage shall be deemed a suspension governed by Section 17.0. The Contractor will resume Work at the direction of the Authority and the terms and conditions of the Contract Documents shall remain in full force and effect.

9.0 COMPENSATION

9.1 Contract Price. The Authority shall pay the Contractor the Contract Price for the Contractor's performance of the Contract. The Contract Price shall be $ [ ]. The Contract Price includes an allowance amount of $1,250,000.00 which constitutes funds set aside by the Authority for use by the Authority in its sole discretion.

9.2 Cost of the Work. The term "Cost of the Work" shall mean costs reasonably incurred by the Contractor in the proper performance of the Work. The Cost of the Work shall include only the following:

9.2.1 Wages of direct employees of the Contractor performing Work at the Project Site or, with the Authority's approval, at locations other than the Project Site.

9.2.2 Wages or salaries of the Contractor's supervisory and administrative personnel engaged to perform Work and who are located at the Project Site or working off-Site to assist in the production or transportation of material and equipment necessary for the Work.

9.2.3 Costs incurred by the Contractor for employee benefits, premiums, taxes, insurance, contributions and assessments required by law, collective bargaining agreements, or which are customarily paid by the Contractor, to the extent such costs are based on wages and salaries paid to the employees of the Contractor as set forth in Sections 9.2.1 and 9.2.2 above.

9.2.4 The reasonable portion of the cost of travel, accommodations and meals for the Contractor's personnel necessarily and directly incurred in connection with the performance of the Work.

9.2.5 Payments properly made by the Contractor to Subcontractors and Subconsultants for performance of portions of the Work, including any insurance and bond premiums incurred by Subcontractors or Subconsultants.

9.2.6 Costs, including transportation, inspection, testing, storage and handling, of materials, equipment and supplies incorporated or reasonably used in completing the Work.

9.2.7 Costs, less salvage value, of materials, supplies, temporary facilities, machinery, equipment and hand tools not customarily owned by the workers that are not fully consumed in the performance of the Work and which remain the property of the Contractor, including the costs of transporting, inspecting, testing, handling, installing, maintaining, dismantling and removing such items.

9.2.8 Costs of removal of debris and waste from the Site.

9.2.9 The reasonable costs and expenses incurred in establishing, operating and demobilizing the Project Site office, including the cost of facsimile transmissions, long-distance telephone calls, postage and express delivery charges, telephone service, internet service, photocopying, and reasonable petty cash expenses.

9.2.10 Rental charges and the costs of transportation, installation, minor repairs and replacements, dismantling and removal of temporary facilities, machinery, equipment and hand tools not customarily owned by the workers, which are provided by the Contractor at the Site, whether rented from the Contractor or others, and incurred in the performance of the Work.

9.2.11 Premiums for insurance and bonds required by Section 15.0 of this Agreement.

9.2.12 All fuel and utility costs incurred in the performance of the Work.

9.2.13 Sales, use or similar taxes, tariffs or duties incurred in the performance of the Work.

9.2.14 Costs for permits, royalties, licenses, tests and inspections incurred by the Contractor required under this Agreement and the Contract Documents.

9.2.15 Costs incurred in preventing damage, injury or loss in case of an emergency affecting the safety of persons or property.

9.2.16 Reimbursement to the Authority for the CM and Architect's travel and professional services beyond two (2) visits to the site resulting from failure to pass tests, approve mock-ups and/or complete Punchlists.

9.2.17 Other costs reasonably and properly incurred in the performance of Work to the extent that such costs are approved by the Authority in writing.

9.3 Non-Reimbursable Costs. The following shall be excluded from the Cost of the Work:

9.3.1 Compensation for the Contractor's personnel stationed at the Contractor's principal or branch offices, except as provided for in Sections 9.2.1 and 9.2.2 above.

9.3.2 Overhead and general expenses, except as provided for in Section 9.2 above, or which may be recoverable for changes to the Work.

9.3.3 The cost of the Contractor's capital used in the performance of the Work.

9.4 Invoices.

9.4.1 On or about the twenty-fifth day of each month, the Contractor shall submit to the Authority a pencil copy of an Invoice, in a form acceptable to the Authority, requesting payment for the Contractor's Work completed during each prior month, so that such pencil copy can be reviewed by the Authority, and any appropriate changes can be made before the Contractor submits the official Invoice on the first day of the next month.

9.4.2 Invoices shall show the percentage of completion of each portion of the Work as of the end of the prior month covered by the Invoice. The percentage of completion shall be the percentage of that portion of the Work which has actually been completed during the prior month.

9.4.3 Each of the Contractor's Invoices shall include:

(a) the Authority's contract number and name of the Project;

(b) all data supporting the amounts requested and any other documentation reasonably requested by the Authority;

(c) a certification by the Contractor that all payments due its Subcontractors and/or Subconsultants have been made from prior paid Invoices and that all Legal Requirements have been complied with; and

(d) if the Contractor is withholding payment from any Subcontractor, Subconsultant or supplier, a certification by the Contractor that a valid basis exists under the terms of the Subcontractor's, Subconsultant's or supplier's contract to withhold payment.

9.4.4 Invoices submitted to the Authority shall be processed and paid only after the Authority reviews and determines that the Work for which payment is sought has been completed at the times and in the manner specified by this Agreement and the Contract Documents. Invoices will not be processed if the Contractor has failed to provide an acceptable Project Schedule or Project Schedule update. Invoices will not be paid by the Authority if the Authority determines that the Work for which payment is sought is incomplete or unsatisfactory.

9.4.5 Invoices may request payment for equipment and materials not yet incorporated into the Project, provided that (i) the Authority is satisfied that the equipment and materials are suitably stored at either the Site or another acceptable location, (ii) the equipment and materials are protected by suitable insurance, and (iii) upon payment, the Authority will receive the equipment free and clear of all liens and encumbrances.

9.4.6 Within thirty (30) Days after receipt of the Contractor's properly supported Invoice, the Authority, pursuant to New Jersey's Prompt Payment Act, N.J.S.A. 52:32-32 et seq. and 2A:30A-2, will make payment of the approved amount of such Invoice, unless within twenty (20) Days of receipt the Authority issues a notice in accordance with the Prompt Payment Act indicating that funds will be withheld, and identifying the amount of the funds to be withheld and the reason for such withholding. The thirty (30) Day period for providing payment to the Contractor shall be extended in circumstances in which authority for an action is required from the Authority's Board of Commissioners. The Authority reserves the right to refuse payment in the amount specified in the Invoice to the extent that the Contractor fails to provide complete and sufficient documentation in support of the amounts claimed.

9.4.7 If the Contractor submits any false or fraudulent Invoice to the Authority for payment, the Contractor shall be held liable and subject to all penalties and damages under the New Jersey False Claims Act, N.J.S.A. 2A:32C-1 et seq.

9.4.8 In the event the Contractor fails to pay its Subcontractors or Subconsultants in a timely manner and the Authority is in full compliance with its obligations regarding timely payment of sums due the Contractor, the Authority may, but is not obligated to, make payments directly to each

Subcontractor or Subconsultant or by two-party checks. The Authority's decision to make such payments to the Contractor's Subcontractors or Subconsultants will not give rise to any liability of the Authority for making such payments, will not in any way require the Authority to exercise its option to make such payments, and will not create any contractual relationship between the Authority and any Subcontractor or Subconsultant. Payments to Subcontractors and Subconsultants will not constitute acceptance of the adequacy of any Work performed by the Contractor or its Subcontractors or Subconsultants.

9.4.9 In the event of a dispute between the Authority and the Contractor as to whether an amount is owed for certain Work, or as to whether an amount has been reasonably withheld by the Authority, the Authority shall pay all amounts that are not in dispute, but shall not be required to pay the amount that is in dispute until the parties settle or otherwise resolve such dispute. The Contractor shall continue to perform all of its obligations under the Contract Documents notwithstanding such dispute.

9.4.10 The Contractor shall receive payment from the Authority by one of the following electronic payment methods: (1) the Automated Clearing House ("ACH") payment system; or (2) wire transfer. Any fees or costs associated with the use of either of the listed electronic payment methods shall be solely the Contractor's responsibility. The Contractor may obtain the documents required to use either electronic payment method from the Authority's website. The Contractor shall provide to CM the documents necessary to use the electronic payment method selected before any payment will be made to the Contractor by the Authority.

9.5 Withholding of Payment.

9.5.1 The Authority may deny the Contractor's Invoice, in whole or in part, if: (a) the Work has not progressed to the point represented by the Contractor in its Invoice; (b) the quality of the Work does not conform to the Contract Documents; (c) defective or deficient Work has not been timely corrected; (d) the Contractor has caused damage to the Authority, the Authority's property or to another contractor; (e) reasonable evidence exists that the Work will not be completed within the Contract Time, or within any Contract Milestones identified in the Schedule; (f) the Contractor has failed or refused to properly schedule and coordinate the Work, or to provide Project Schedules and updates; or (g) the Contractor has failed or otherwise refused to comply with any term in the Contract Documents.

9.5.2 If the Authority determines that a sufficient basis exists to deny payment requests from the Contractor pursuant to Section 9.5.1, the Authority will either: (i) retain the relevant Invoice (or portion thereof) until such time as the Contractor has made the necessary corrections/deliveries; or (ii) return the relevant Invoice to the Contractor, who shall resubmit the Invoice once all of the Work has been satisfactorily completed or corrected.

9.5.3 The refusal to certify any sums pursuant to this Section shall not be construed as, or constitute in any manner, a waiver by the Authority of the Contractor's obligation to perform the Work required under this Contract Documents. In the event that the Contractor fails to perform any Work required by Contract Documents, the Authority shall have, in addition to the sums for which certification is denied in accordance with this Section, all rights and remedies provided by law, equity and this Agreement.

9.6 Retainage.

9.6.1 Except as otherwise provided herein, the Authority shall withhold funds ("Retainage") from payments made to the Contractor in accordance with this Section. The Authority shall withhold two percent (2%) from all invoiced amounts in accordance with N.J.S.A. 40A:11-16.3.

9.6.2 At the time of Final Payment, the Authority shall release to the Contractor all Retainage other than amounts applied to the payment of Liquidated Damages or amounts which the Authority in its sole discretion deems necessary to retain to cover any existing or threatened claims or liens, or any amounts otherwise due the Authority under this Agreement.

9.7 Other Deductions.

9.7.1 In addition to Retainage, the Authority may deduct from any payment the following:

(a) any Liquidated Damages which have accrued as of the date of the application for payment;

(b) any sums expended or expected to be expended by the Authority in performing any of the Contractor's obligations under the Contract Documents which the Contractor has failed to perform or has deficiently performed; and

(c) any other sums which the Authority is entitled to recover from the Contractor under the terms of the Contract Documents.

9.7.2 the Contractor agrees that, to the extent that the Authority may deduct or withhold money from the Contractor pursuant to the terms of this Contract, the Authority has available to it any monies due or that may become due the Contractor under other contracts between the Contractor and the Authority. Such other contracts shall include joint ventures in which the Contractor is a participant, but only to the extent of its participation. The right to recover against the Contractor as herein provided is in addition to and does not affect the right of the Authority to seek recovery against the Contractor or surety under the Contract, bonds, or as otherwise allowed by law.

10.0 SUBSTANTIAL COMPLETION AND FINAL COMPLETION

10.1 Substantial Completion Date. Substantial Completion of the Work under the Contract Documents shall be achieved no later than the Substantial Completion Date identified in Attachment A ("Substantial Completion Date"). Final Completion of the Work shall be achieved within [ ] Days of the Substantial Completion Date ("Final Completion Date").

10.2 Substantial Completion.

10.2.1 Requirements for Substantial Completion. The Architect in conjunction with CM shall determine the date that the Contractor achieves Substantial Completion for the Project. In order to achieve Substantial Completion, the Contractor must have achieved the following on the Project: (i) all essential requirements of the Contract Documents have been performed so that the purpose of the Contract Documents have been accomplished; (ii) a Temporary Certificate of Occupancy has been issued by the City of Elizabeth; (iii) a Punchlist has been created by the Architect , in conjunction with the CM and the Authority; (iv) the Contractor has delivered to the Authority the key(s) and/or code(s) for operation of the elevators; (v) there are no material omissions or technical defects or deficiencies, as identified by the Authority; and (vi) the Project is one-hundred percent (100%) ready for occupancy in accordance with its intended use.

10.2.2 Punchlist and Certificate of Substantial Completion. Once the Contractor believes that it has reached Substantial Completion of the Project but for preparation of the Punchlist, the CM shall inspect the Project in conjunction with the Architect and the Authority. If the Authority, the Architect, and CM determine that Substantial Completion has been achieved but for preparation of the Punchlist, the CM, in conjunction with the Authority and the Architect, shall prepare a Punchlist. Once the Punchlist is complete, the Authority shall distribute to the Contractor a Certificate of Substantial Completion with an attached Punchlist. As the Contractor corrects the Work identified on the Punchlist, the Architect and CM shall update the Punchlist and ensure and verify that the Contractor corrects the incomplete or defective Work as required by the Contract Documents.

10.3 Liquidated Damages.

10.3.1 Inasmuch as delays in the completion of the Work may result in an increase in costs to the Authority, the precise amount of which may be difficult to ascertain, it is hereby agreed that if Substantial Completion is not achieved on or before the Substantial Completion Date (as extended pursuant to the provisions of this Agreement), the Authority shall be entitled to receive a credit in the amount of $1,500 per day. if Substantial Completion has not been achieved by the contractual Substantial Completion Date.

10.3.2 The Authority and the Contractor agree that the actual damages that would be suffered by Authority if Substantial Completion and/or Final Completion of the Work is delayed are speculative and not susceptible of precise determination and that the specified liquidated damages amounts (either in this Agreement or in any Change Order) represent a reasonable estimate by the Authority and the

Contractor of the damages that the Authority would suffer in such event and, therefore, constitute damages and not a penalty.

10.3.4 The Authority shall have the right to deduct Liquidated Damages from any amounts, including Retainage, owed by the Authority to the Contractor or its surety. If Liquidated Damages are not deducted from such amounts, Liquidated Damages shall be payable by the Contractor to the Authority within ten (10) Days after receipt by the Contractor of a demand for payment of Liquidated Damages by the Authority.

10.4 Final Completion.

10.4.1 Certificate of Final Completion. The Authority shall issue a Certificate of Final Completion and determine the date of Final Completion of the Project. Final Completion means that point in time on the Project when: (i) all requirements of the Contract Documents have been completed in a manner consistent with the Architect Documents; (ii) all items on the Punchlist have been performed; and (iii) a Final Certificate of Occupancy, or a Certificate of Acceptance, as applicable, has been issued. Following the issuance of a Certificate of Substantial Completion for the Project and the Contractor's determination that the Punchlist Work has been completed, the Contractor, in conjunction with the CM and the Architect, shall evaluate the Work and notify the Authority when the Work is ready for final inspection. the Contractor shall, in conjunction with the Authority, CM, and the Architect, conduct a final inspection of the Work to ensure that all Punchlist Work has been completed and all nonconforming and/or deficient Work has been corrected or remedied. The Architect shall evaluate the Work to ensure that all Work and all Punchlist Work has been completed in a manner consistent with the Contract Documents. the Contractor shall assist the Authority in issuing a Certificate of Final Completion.

10.5 Final Payment.

10.5.1 Final Payment shall be made by the Authority to the Contractor only when:

(a) This Agreement has been fully performed by the Contractor, including all requirements set forth in the Contract Documents;

(b) The final Invoice and final accounting have been submitted by the Contractor and have been reviewed and approved by the Authority;

(c) Final releases have been obtained from the Contractor, its Subcontractors and Subconsultants;

(d) The Authority has accepted the Work under this Agreement and the Contract Documents; and

(e) The Contractor has provided to the Authority all manuals, warranties and as-built drawings for the Project.

10.5.2 If all requirements for Final Payment have been fulfilled by the Contractor, the Authority shall make the Final Payment in accordance with the New Jersey Prompt Payment Act.

10.6 Final Release.

10.6.1 The acceptance of Final Payment by the Contractor shall constitute a waiver of all claims by the Contractor against the Authority except for: (i) those claims expressly reserved by the Contractor at the time of Final Payment; and (ii) those claims arising after Final Payment due to an alleged breach by the Authority of any provision of the Agreement which survives after the Term.

10.6.2 Acceptance of, or payment for, any of the Work performed by the Contractor shall not constitute a release or waiver of any claim the Authority has or may have against the Contractor for latent defects, errors, omissions, deficiencies, breaches of contract, or negligence. If the Authority discovers latent defects, errors, omissions or deficiencies in the Work after Final Release, the Contractor shall correct any such defects, errors, omissions or deficiencies in the Work at no expense to the Authority.

10.6.3 All payments for Work performed under this Agreement will be made only to the Contractor, except as expressly stated in this Agreement. the Contractor shall assume sole and full responsibility for payments due to any of its Subcontractors, Subconsultants or suppliers.

10.6.4 Notwithstanding any other provision of the Contract, for a period of three (3) years after Final Completion of the Project, all estimates and payments made pursuant to the Contract Documents, including the Certificates of Final Completion and Final Payment, are subject to correction and adjustment for clerical or other errors in the calculations involved in the determination of the amount of the payments. the Contractor and the Authority agree to pay to the other any sum due under the provisions of this Section, provided, however, that if the total sum to be paid is less than $100, payment will be waived.

11.0 THE AUTHORITY'S RESPONSIBILITIES

In addition to other responsibilities of the Authority as set forth in this Agreement and the Contract Documents, the Authority shall:

11.1 Provide the Contractor with the design package.

11.2 Cooperate with the Contractor throughout the Term of this Agreement. The Authority shall perform its responsibilities, obligations and services, including review and acceptance of the Contractor's submissions, in a timely manner so as not to delay or interfere with the Contractor's performance of its obligations under this Agreement.

11.3 Provide, at its own cost and expense and to the extent available, for the Contractor's information and use, the following:

11.3.1 Surveys describing the property, boundaries, topography and reference points for use during design and construction, including existing service and utility lines;

11.3.2 Geotechnical studies describing subsurface conditions, and other surveys describing other latent or concealed physical conditions at the Site;

11.3.3 A legal description of the Site;

11.3.4 Information on underground obstructions; and

11.3.5 Environmental studies, reports and impact statements describing the environmental conditions, including hazardous conditions existing at the Site.

11.4 Attend Project related meetings and participate in inspections, as necessary.

12.0 TERM

The Term of this Agreement shall be from the Commencement Date and shall extend until all obligations of the Contractor perform Work pursuant to the Contract Documents have been performed to the satisfaction of the Authority, unless extended or sooner terminated as set forth in this Agreement.

13.0 WARRANTIES

13.1 General. The Contractor warrants to the Authority that the construction, including all materials and equipment furnished as part of the construction, shall be new unless otherwise specified in the Contract Documents, of good quality, in conformance with the Contract Documents and free of defects in materials and workmanship.

13.2 Commencement of Warranties. The warranties shall commence upon Substantial Completion of the Project and continue for one (1) year, unless otherwise stated in the Contract Documents. Should any warranty commence earlier than the Substantial Completion Date, the Contractor shall extend the warranty to one (1) year past the Substantial Completion Date. The Contractor's warranty obligations exclude defects caused by abuse, alterations, or failure to maintain the Work by persons other than the Contractor. Nothing in this Section is intended to limit any manufacturers' warranties which provide the Authority with greater warranty rights than those set forth in this Section or the Contract Documents.

The Contractor will provide the Authority with all manufacturers' warranties upon Substantial Completion.

13.3 Warranty Inspection. Approximately eleven (11) months after Final Payment, the Authority shall conduct, in conjunction with the CM, a warranty inspection of the Work. The Contractor shall, at no cost to the Authority, correct any deficiencies, latent defects, or warranty work discovered in the 11-month warranty inspection.

13.4 Subcontractor, Subconsultant and Supplier Warranties. the Contractor shall obtain appropriate warranties, guarantees, and obligations with respect to materials, workmanship, equipment, tools, and supplies furnished by any and all Subcontractors, Subconsultants, and suppliers, and shall cause such warranties, guarantees and obligations to be extended to the Authority without derogating the Contractor's own representations and warranties to the Authority for such Work. The foregoing warranties, guarantees, and obligations shall be in effect for periods of time co-extensive in duration with the Contractor's warranty for such Work. All such warranties, guarantees, and obligations shall be in writing and shall run directly to and be jointly and severally enforceable by the Contractor and/or the Authority and their respective successors or assigns. the Contractor shall be responsible for enforcing such warranties, guarantees, and obligations, at its own expense, in the name of and on behalf of the Authority if the Authority so requests.

13.5 As-Built Drawings. The Contractor shall provide As-Built Drawings acceptable to the Authority, the CM, and the Architect.

14.0 PERFORMANCE AND PAYMENT BOND

14.1 The Contractor shall furnish within five (5) Days of receipt of the Notice of Award a Performance and Payment Bond in a form approved by the Authority, in an amount equal to one hundred percent (100%) of the Contract Price guaranteeing the due and timely performance of all obligations of the Contractor under this Agreement. No contract shall be executed by the Authority unless and until this required bond is submitted and approved by the Authority.

14.2 The surety issuing the bond must be currently authorized to do business in the State of New Jersey.

14.3 The bond shall cover all guarantees and warranties required by the Contract Documents, and all alterations, extensions of Contract Time, Changes in the Work, and other changes authorized by the Contract Documents, without the need to secure the consent of the surety or sureties.

14.4 Bonds must be legally effective as of the date this Agreement is executed. Each bond must indicate the Contractor's name exactly as it appears in this Agreement. Current attorney-in-fact instruments and financial statements of the surety must be included for each bond. An authorized officer

or agent of the surety must execute the bonds. All bonds and the sureties that write them must conform in all respects to the requirements of applicable State law.

15.0 INSURANCE REQUIREMENTS – THE CONTRACTOR

The Contractor shall maintain the following kinds of insurance with the limits not less than the amounts indicated. All insurers must have an AM Best's rating of at least A- Class VII. The specifications outlined are standard industry Insurance Services Office (ISO) forms that are used by most insurers. In the event a carrier utilizes a proprietary policy form, the agent or broker must provide a statement that the policy provides a scope of coverage at least as broad as the requested ISO form.

Prior to the commencement of any work, the Contractor will provide a Certificate of Insurance evidencing the following coverage and shall include as terms of the Agreement the following as Additionally Insured: the Authority, their officers, directors and employees, the County of Union, MAST Construction Services, Inc., The DIGroup Architecture, and their Consultants.

Any combination of primary and umbrella/excess policies may be used to satisfy the limits. All the provisions below shall also apply to the umbrella/excess policies for such coverages listed below.

Commercial General Liability (CGL): Coverage for all operations including, but not limited to, contractual, products and completed operations, and personal injury with limits no less than $10,000,000 per occurrence/$10,000,000 aggregate. The Authority its officers, officials, employees, agents and volunteers shall be included as an additional insured.

Automobile Liability: Coverage for all owned, non-owned and hired vehicles with limits not less than $5,000,000 per occurrence, combined single limits (CSL) or its equivalent.

Workers Compensation: As required by the State of New Jersey and Employers Liability with limits not less than $1,000,000 per accident for bodily injury or disease.

Professional Liability (if design/build): Coverage with limits not less than $10,000,000 per occurrence or claim, $10,000,000 aggregate.

Cyber Liability: $5,000,000 per claim/$5,000,000 aggregate.

Contractor's Pollution Legal Liability and/or Asbestos Legal Liability and/or Errors & Omissions (if project involves environmental hazards): Coverage with limits no less than $10,000,000 per occurrence or claim/$10,000,000 aggregate.

Builders Risk: The Authority is responsible to provide and maintain Builders Risk Insurance.

Special Risks or Circumstances: The Authority reserves the right to modify these requirements, including limits, based on the nature of the risk, prior experience, insurer, coverage, or other special circumstances.

15.2 Self-Insured Retentions

Self-insured retentions must be declared to and approved by the Authority. At the option of the Authority, either: the Contractor shall cause the insurer to reduce or eliminate such self-insured retentions as respects the Authority, its officers, officials, employees, and volunteers; or the Contractor shall provide a financial guarantee satisfactory to the Authority guaranteeing payment of losses and related investigations, claim administration, and defense expenses. The policy language shall provide, or be endorsed to provide, that the self-insured retention may be satisfied by either the named insured or the Authority.

15.3 - Other Insurance Provisions

The insurance policies are to contain, or be endorsed to contain, the following provisions:

15.3.1. The Authority, its officers, officials, employees, and volunteers are to be covered as additional insureds on the CGL policy with respect to liability arising out of work or operations performed by or on behalf of the Contractor including materials, parts, or equipment furnished in connection with such work or operations and automobiles owned, leased, hired, or borrowed by or on behalf of the Contractor. General liability coverage can be provided in the form of an endorsement to the Contractor's insurance.

15.3.2. For any claims related to this Project, the Contractor's insurance coverage shall be primary insurance coverage as to the Authority, its officers, officials, employees, and volunteers. Any insurance or self-insurance maintained by the Authority, its officers, officials, employees, or volunteers shall be excess of the Contractor's insurance and shall not contribute with it.

15.3.3. Each insurance policy required by this clause shall provide that coverage shall not be canceled, except with notice to the Authority.

15.4 - Claims Made Policies (If at all possible, avoid and require occurrence type CGL policies)

If any coverage required is written on a claims-made coverage form:

15.4.1. The retroactive date must be shown, and this date must be before the execution date of the Contract or the beginning of Contract Work.

15.4.2. Insurance must be maintained, and evidence of insurance must be provided for at least five (5) years after completion of Contract Work.

15.4.3. If coverage is cancelled or non-renewed, and not replaced with another claims-made policy form with a retroactive date prior to the Contract effective, or start of work date, the Contractor must purchase extended reporting period coverage for a minimum of five (5) years after completion of Contract Work.

15.4.4. If the services involve lead-based paint or asbestos identification/remediation, the Contractors Pollution Liability policy shall not contain lead-based paint or asbestos exclusions. If the services involve mold identification/remediation, the Contractor's Pollution Liability policy shall not contain a mold exclusion, and the definition of Pollution shall include microbial matter, including mold.

16.0 GENERAL COVENANTS

16.1 Ownership of Documents.

16.1.1 The Authority and the Contractor acknowledge that during the course of, and as a result of, the performance of the Work, the Contractor or its Subconsultants will create written materials, plans, drawings, specifications, computer files, or other tangible manifestations of the Contractor's efforts under this Agreement and the Contract Documents, including architectural work, as that term is defined in the Architectural Works Copyright Protection Act of 1990 (hereinafter individually or collectively referred to as "Work Product"). All Work Product furnished or prepared by the Contractor and/or its Subconsultants shall at all times be the property of the Authority, and may be used by the Authority to complete the Project in the event that the Authority elects to terminate or cancel this Agreement pursuant to any provision hereof or for any other purpose set forth in Section 16.1.4 below. The Authority's ownership of the Work Product shall commence immediately upon the Effective Date of this Agreement, and shall commence regardless of payment by the Authority of any compensation to the Contractor, and regardless of delivery of any such Work Product to the Authority.

16.1.2 The Contractor hereby assigns to the Authority sole ownership of any copyrights or other intellectual property rights created or existing under state or federal law in any and all Work Product prepared by the Contractor or its Subconsultants pursuant to this Agreement.

16.1.3 All Work Product (including the original, one (1) set of electronic copies, and two (2) sets of hard copies thereof) shall be returned to the Authority upon the termination or expiration of this Agreement, except that the Contractor may, subject to any confidentiality obligations under this Agreement, retain one or more record sets of the Work Product.

16.1.4 All Work Product may be referred to freely by the Authority for the purpose of appending any addition to and integrating the same with the Project, performing any alterations or repairs of any portion of the Project or designing or constructing other similar facilities, buildings or projects whenever and wherever the Authority shall desire; provided however, that the Contractor shall not thereafter be

responsible for any misuse, alteration or interpretation of such Work Product. Work Product shall not be used on any other project by the Contractor.

16.1.5 The Contractor shall be liable to, and hereby agrees to indemnify and hold harmless the Authority, the Architect and the CM, from and against all claims made against any of them for infringement of any copyright or patent arising out of the Work Product prepared or furnished by the Contractor in the performance of this Agreement.

16.1.6 If the Contractor is terminated under this Agreement and the Authority retains a substitute design professional to complete the Work Product, the Contractor shall have no liability to the Authority for modifications to the Work Product made by others.

16.1.7 The Contractor agrees that the Architect shall have the right to include photographic or artistic representations of the design of the Project among the Architect's promotional and professional materials. The Architect shall be given reasonable access to the completed Project to make such representations. The Contractor shall provide professional credit to the Architect, as the "Design Architect of Record" in the Contractor's promotional materials for the Project, including, but not limited to any signs located at the Project site.

16.2 Copyrights and Patents.

16.2.1 If the Contractor employs any design, device, material, or process covered by letters of patent or copyright, it shall provide for such use by suitable legal agreement with the patent holder. The Contractor shall assume all costs, including attorney's fees, arising from its use of patented or copyrighted designs, materials, equipment, devices, or processes for this Project.

16.2.2 The Contractor shall defend, indemnify and hold harmless the Authority and the State from any and all claims for infringement by reason of the use of any patented design, device, material, equipment or process, or any trademark, copyright, trade secret or any other material protected in any manner from use or disclosure, and shall indemnify the Authority and the State for any costs, expenses and damages, including attorney's fees, that it may incur by reason of an infringement at any time during the performance, or after the acceptance, of the Work.

16.3 Confidentiality.

16.3.1 All data contained in Documents supplied by the Architect, the Authority, or any other party involved in the Project, and after the execution of this Agreement, any data gathered by the Contractor in fulfillment of this Agreement and any analyses thereof (whether in fulfillment of this Agreement or not), are to be considered confidential and shall be solely for use in connection with the Project. Notwithstanding the foregoing, the Authority will comply with all applicable laws with regard to releasing such information which has been properly requested pursuant to such laws.

16.3.2 The Contractor shall not disclose to any third party the contents of the information, reports, findings, analyses, surveys, data or any other materials generated or produced in performance of this Agreement and the Contract Documents, or provide copies of same, without the prior, written consent of the Authority, except where disclosure of such materials is legally required by order of court or administrative agency, whether State or Federal, in which case the Contractor shall provide immediate notice to the Authority of such order.

16.3.3 The Contractor is required to use reasonable care to protect the confidentiality of the Project data by, among other things, requiring incorporation of this Section 16.3 into its contract(s) with Subcontractors and Subconsultants. Any use, sale or offering of this data in any form by the Contractor, its employees, Subcontractors, Subconsultants or assignees will be considered a material breach of this Agreement. The Contractor shall be liable for any and all damages arising from its breach of this confidentiality provision, including damages, costs and/or attorney's fees. The Authority shall also have the right to terminate this Agreement for cause in the event of a breach of this confidentiality provision without the Authority being liable for damages, costs and/or attorney's fees.

16.3.4 Any publicity and/or public announcements pertaining to the Project shall not be made until and unless the Contractor obtains the prior, written approval of the Authority.

16.3.5 The Contractor's promotional and professional (or other) materials shall never include the Authority's confidential or proprietary information.

16.4 Contractual Relationship.

16.4.1 Nothing in this Agreement shall be construed as creating a contractual relationship between the Authority and any Subcontractors, Subconsultants, or suppliers of the Contractor.

16.4.2 The Contractor's status shall be that of an independent contractor, not an employee of the Authority. The Contractor agrees that it will conduct itself consistent with such status, that it will neither hold itself out as, nor claim to be, an officer or employee of the Authority by reason hereof. The Contractor will not, by reason hereof, make any claim, demand or application to any Authority officer or employee for any right or privilege afforded to an Authority officer or employee, including, but not limited to, worker's compensation, unemployment or other insurance benefits, social security coverage, or retirement membership or credit.

16.4.3 The Contractor shall include in all of its Subcontractor and Subconsultant contracts a requirement that each Subcontractor or Subconsultant is bound by the terms and conditions of this Agreement and the Contract Documents.

16.4.4 Nothing contained in this Agreement shall create a contractual relationship with a third party or create a cause of action in favor of a third party against the Contractor or the Authority. It is

further intended that no individual, firm, corporation, or any combination thereof, which supplies materials, labor, services or equipment to the Contractor for this Project thereby becomes a third-party beneficiary of this Agreement.

16.4.5 The Authority and the Contractor hereby bind themselves, their partners, successors, assigns, and legal representatives to the other party to this Agreement.

16.5 Assignment.

16.5.1 The Contractor shall not assign or transfer its obligations, privileges or rights under this Agreement without the prior, written consent of the Authority. Any assignment or transfer of the Contractor's rights under this Agreement without the prior, written consent of the Authority shall not relieve the Contractor of any duty, obligation or liability assumed by it under this Agreement.

16.5.2 In the event the Authority approves an assignment, the Contractor shall submit to the Authority: (i) corporate resolutions prepared by the Contractor and the new entity ratifying this Agreement; (ii) information necessary to ensure that the new entity satisfies the Authority's pre-qualification policies and procedures; (iii) the names and addresses of all owners and potential owners which hold or may acquire five percent (5%) or more of its stock or interest; (iv) any new or changed Federal Employer Identification Number(s); (v) acknowledgment and acceptance of all rights, duties and obligations of this Agreement without limitation by the new entity; and (vi) any other information which the Authority may require.

16.5.3 Notwithstanding anything to the contrary, under no circumstance shall the Contractor assign its right to receive money under this Agreement for any purpose or to any person whatsoever without the prior, written approval of the Authority.

16.5.4 The Authority may elect, in its sole discretion, to assign this Agreement to any other State agency, authority or other State instrumentality, or any local or municipal instrumentality, at any time during the Term of this Agreement. In such case, the Contractor agrees to continue to perform all of its obligations as set forth in this Agreement. The Contractor shall make no claim against the Authority in the event of such assignment and shall execute such certificates, Documents and instruments as may be reasonably requested by the Authority to effect such assignment.

16.6 Mergers, Acquisitions, and Dissolutions.

16.6.1 If, subsequent to the execution of this Agreement, the Contractor proposes to merge with or be acquired by another firm, or in the event of a proposed dissolution by the Contractor, the Contractor shall immediately notify the Authority and shall submit, in advance, documentation to the Authority describing the proposed merger, acquisition or dissolution.

16.6.2 The Authority, in its sole discretion, may approve the proposed merger, acquisition or dissolution or terminate this Agreement for cause. The Authority will notify the Contractor of its decision within thirty (30) Days of receipt by the Authority of documentation from the Contractor describing the proposed merger, acquisition or dissolution.

16.6.3 In the event the Contractor seeks the Authority's approval of a proposed merger or acquisition, the Contractor shall submit to the Authority: (i) corporate resolutions prepared by the Contractor and the new entity ratifying this Agreement; (ii) information necessary to ensure that the new entity satisfies the Authority's pre-qualification policies and procedures; (iii) the names and addresses of all owners and potential owners that hold or may acquire five percent (5%) or more of its stock or interest; (iv) any new or changed Federal Employer Identification Number(s) for the new entity; (v) acknowledgment and acceptance of all rights, duties and obligations of this Agreement without limitation by the new entity; and (vi) any other information which the Authority may require.

16.6.4 In the event the Contractor seeks the Authority's approval of a dissolution, the Contractor shall submit to the Authority: (i) a copy of the corporate resolution, or the written statement of the partnership, general partner, receiver or custodian thereof, or the written agreement of the principal parties of a joint venture to dissolve the corporation, partnership or joint venture, respectively; (ii) any new or changed Federal Employer Identification Number(s); (iii) acknowledgment of the assumption of all rights, obligations and duties of this Agreement without limitation by the new parties; and (iv) any other information which the Authority may require.

16.7 Mandatory Compliance With Law.

16.7.1 The Contractor must comply with all applicable Legal Requirements. To the extent variances from such Legal Requirements are required, the Contractor and the Authority shall cooperate to pursue such variances in the interests of the Project.

16.7.2 The Contractor shall be knowledgeable of the Legal Requirements applicable in the jurisdiction in which the Project is located, and the Contractor agrees to comply with such Legal Requirements, including without limitation, (i) the Americans with Disabilities Act, (ii) insurance industry standards, surveys and other information provided by the Authority, and (iii) development covenants and conditions and easements applicable to the Site on which the Project is located, regardless of whether the Authority has furnished the Contractor with the foregoing information.

16.7.3 Each and every provision required by law to be inserted into this Agreement and the Contract Documents by this Agreement shall be deemed to have been inserted therein. If any such provision has been omitted or has not been correctly inserted, the Contract Documents shall be amended, upon application of either Party, to provide for such insertion or correction.

16.7.4 If the Authority determines that the Contractor has violated or failed to comply with any applicable Legal Requirements with respect to its performance under this Agreement and the Contract Documents, the Authority may withhold payments for such performance and take such action that it deems appropriate until the Contractor has complied with such Legal Requirements or has remedied such violation or non-compliance to the satisfaction of the Authority.

16.7.5 The Contractor's compliance with applicable Legal Requirements is mandatory and cannot be waived by the Authority.

16.7.6 The Contractor shall ensure that its payments to vendors, Subcontractors and Subconsultants are made in compliance with the New Jersey Prompt Payment Act, N.J.S.A. 2A:30A-1 and -2, and the provisions of N.J.S.A. 52:32-40 and N.J.S.A. 52:32-41, and all other applicable laws concerning prompt payment to Subcontractors and Subconsultants.

16.7.7 The Contractor and each of its Subcontractors shall comply with the New Jersey Prevailing Wage Act Laws of 1963, Chapter 150 (N.J.S.A. 34:11-56.25 et seq.), and all amendments thereto.

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16.8 Affirmative Action and Non-discrimination.

16.8.1 The Contractor shall submit to the Authority, after notification of award but prior to execution of this Agreement, one of the following three documents: (i) documentation (e.g., a Letter of Approval) sufficient to show that the contractor is operating under an existing Federally-approved or sanctioned affirmative action program; (ii) a Certificate of Employee Information Report approval issued in accordance with N.J.A.C. 17:27-4; or (iii) an Employee Information Report (Form AA-302) in accordance with N.J.A.C. 17:27-4. The Contractor shall not enter into a subcontract unless the subcontractor has submitted to said contractor one of the three documents required in this paragraph above, unless such subcontractor has four or fewer employees.

16.8.2 The Contractor shall abide by, and shall include language in all subcontracts with Subcontractors and Subconsultants requiring that all Subcontractors and Subconsultants abide by the following requirements of this Section 16.8.

16.8.3 The Contractor shall not discriminate in employment and shall abide by all anti-discrimination laws including those contained within N.J.S.A. 10:5-1 et seq. and all rules and regulations issued thereunder. During the performance of this Agreement, the Contractor, its Subcontractors and its Subconsultants agree as follows:

16.8.3.1 The Contractor and its Subcontractors and Subconsultants will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation or sex. Except with respect to affectional or sexual orientation, the Contractor, or Subcontractor or Subconsultant will take

affirmative action to ensure that such applicants are recruited and employed, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation or sex. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor and its Subcontractors and Subconsultants agree to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

16.8.3.2 The Contractor, and its Subcontractors and Subconsultants, will in all solicitations or advertisements for employees placed by or on behalf of the Contractor or Subcontractor or Subconsultant, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation or sex.

16.8.3.3 The Contractor and its Subcontractors and Subconsultants will send to each labor union or representative of workers with which they have a collective bargaining agreement or other contract or understanding, a notice advising the labor union or workers' representative of the Contractor's (and its Subcontractor's and Subconsultant's) commitments under this Agreement and referenced statutes and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

16.8.3.4 The Contractor and its Subcontractors and Subconsultants shall comply with the regulations promulgated by the State Treasurer pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time, and with the Americans With Disabilities Act, 42 U.S.C. § 12101 et seq., with respect to its employment practices.

16.8.3.5 The Contractor and its Subcontractors and Subconsultants agree to attempt in good faith to employ minority and female workers consistent with the applicable county employment goals prescribed by N.J.A.C. 17:27-5.2, as amended and supplemented from time to time, or in accordance with a binding determination of the applicable county employment goals determined by the Division of Contract Compliance & Equal Employment Opportunity in Public Contracts (hereinafter, the "Division") pursuant to N.J.A.C. l7:27-5.2, as amended and supplemented from time to time. The applicable employment goals for Union County can be obtained from the New Jersey Department of Treasury Equal Employment Opportunity and Affirmative Action website at https://www.nj.gov/treasury/contract_compliance/.

16.8.3.6 The Contractor and its Subcontractors and Subconsultants agree to inform, in writing, appropriate recruitment agencies in the area, including employment agencies, placement bureaus, colleges, universities and labor unions, that it does not discriminate on the basis of age,

creed, color, national origin, ancestry, marital status, sex, affectional or sexual orientation, and that it will discontinue the use of any recruitment agency which engages in direct or indirect discriminatory practices.

16.8.3.7 The Contractor and its Subcontractors and Subconsultants agree to revise any of its testing procedures, if necessary, to ensure that all personnel testing conforms to the principles of job-related testing, as established by the statutes and court decisions of the State of New Jersey and as established by applicable Federal law and applicable Federal court decisions.

16.8.3.8 In conforming with the applicable employment goals, the Contractor and its Subcontractors and Subconsultants agree to review all of their procedures relating to transfer, upgrading, downgrading and layoff to ensure that all such actions are taken without regard to age, creed, color, national origin, ancestry, marital status, sex, affectional or sexual orientation, consistent with the statutes and court decisions of the State of New Jersey, and applicable Federal law and applicable Federal court decisions.

16.8.3.9 The Contractor and its Subcontractors and Subconsultants shall furnish to the Division such reports or other documents as may be requested from time to time in order to carry out the purposes of the Division's regulations, and shall furnish to the Authority such reports and other documents, in the manner and form requested, as may be required to carry out the purposes of the Authority's regulations.

16.8.3.10 The Contractor and its Subcontractors and Subconsultants, agrees to make good faith efforts when hiring or scheduling workers in each construction trade, to employ minority and women workers in each construction trade consistent with the applicable employment goal prescribed by N.J.A.C. 17:27-7.3; provided, however, that the Division may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by Sections 16.8.3.11 and 16.8.3.12 below, as long as the Division is satisfied that the contractor or subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Division that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the applicable employment goal established in accordance with N.J.A.C. 17:27-7.3. the Contractor and its Subcontractors and Subconsultants agree that a good faith effort shall include compliance with the following procedures:

16.8.3.11 If the Contractor or its Subcontractor or Subconsultant has a referral agreement or arrangement with a union for a construction trade, the Contractor or its Subcontractor or Subconsultant shall, within three business days of the contract award, seek assurances from the union that the union will cooperate with the Contractor or its Subcontractor or Subconsultant as it fulfills its affirmative action obligations under this contract and in accordance with the rules

promulgated by the Treasurer, pursuant to N.J.S.A. 10:5-31 et seq., as supplemented and amended from time to time. If the Contractor or its Subcontractor or Subconsultant is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the Contractor or its Subcontractor or Subconsultant shall agree to attempt to hire or schedule minority and women workers directly, consistent with the applicable employment goal. If the Contractor's or Subcontractors' or Subconsultants' prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with the applicable employment goal, the Contractor or its Subcontractor or Subconsultant agrees to be prepared to hire or schedule minority and women workers directly, consistent with the applicable employment goal, by complying with the hiring or scheduling procedures prescribed under Section 16.8.3.12 below; and the Contractor or its Subcontractor or Subconsultant further agrees to take said action immediately if it determines or is so notified by the Division that the union is not referring minority and women workers consistent with the applicable employment goal.

16.8.3.12 If the hiring or scheduling of a workforce consistent with the employment goal has not or cannot be achieved for each construction trade by adhering to the procedures of Section 16.8.3.11 above, or if the Contractor or a Subcontractor or Subconsultant does not have a referral agreement or arrangement with a union for a construction trade, the Contractor or the Subcontractor or Subconsultant agrees to take the following actions consistent with the applicable county employment goals:

(a) To notify the public agency compliance officer, the Division, and minority and women referral organizations listed by the Division pursuant to N.J.A.C. 17:27-5.3, of its workforce needs, and request referral of minority and women workers

(b) To notify any minority and women workers who have been listed with it as awaiting available vacancies;

(c) Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the Contractor or its Subcontractor or Subconsultant has a referral agreement or arrangement with a union for the construction trade;

(d) To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State training and employment service and other approved referral sources in the area until such time as the workforce is consistent with the employment goal;

(e) If it is necessary to lay off any of the workers in a given trade on the construction site, to assure, consistent with the applicable State and Federal statutes and court decisions, that sufficient minority and women employees remain on the site consistent with the employment goal; and to employ any minority and women workers laid off by the contractor on any other construction site on which its workforce composition is not consistent with an employment goal established pursuant to rules implementing N.J.S.A. 10:5-31 et seq.;

(f) To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:

1. If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the Contractor or its Subcontractor or Subconsultant shall determine the qualifications of such individuals and if the Contractor's, or Subcontractor's or Subconsultant's workforce in each construction trade is not consistent with the applicable employment goal, it shall hire or schedule those individuals who satisfy appropriate qualification standards. However, the Contractor or the Subcontractor or Subconsultant shall determine that the individual at least possesses the requisite skills, and experience as recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Division. If necessary, the Contractor, Subcontractor or Subconsultant shall hire or schedule minority and women workers who qualify as trainees pursuant to these rules. All of these requirements, however, are limited by the provisions of Section 16.8.3.13 below.

2. If the Contractor's or Subcontractors' or Subconsultants' workforce is consistent with the applicable employment goal, the name of any interested women or minority individual shall be maintained on a waiting list for the first consideration, in the event the contractor's or subcontractor's workforce is no longer consistent with the applicable employment goal.

3. If, for any reason, the Contractor or Subcontractor or Subconsultant determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the Contractor or Subcontractor or Subconsultant shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the Authority compliance officer and to the Division; and

(g) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Division and submitted promptly to the Division upon request.

16.8.3.13 The contractor or subcontractor agrees that nothing contained in Section 16.8.3.12 above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union

hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to Section 16.8.3.12 above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey workers ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of Section 16.8.3.12 above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

16.8.4 Monitoring and Enforcement of Workforce Affirmative Action Compliance and Procedures.

16.8.4.1 The Contractor's employee liaison shall meet, when requested, with the Authority's workforce compliance inspector to ensure compliance with this section and the contractor's affirmative action plan.

16.8.4.2 The Authority's compliance inspector shall conduct on-site visits and/or attend project meetings and, at reasonable times and in a reasonable manner, may enter the Contractor's business facility or construction project site for the purpose of determining whether the Contractor is complying with its affirmative action plan and is otherwise in compliance with the procedures set forth in this chapter.

16.8.4.3 The Authority's compliance inspector may investigate to determine if there is a violation of this subchapter or the Contractor's affirmative action plan. If the workforce compliance inspector determines there is substantial probability that a violation is occurring, he or she may issue a written alert notice to the Contractor. The written alert notice shall explain in sufficient detail the alleged violation.

16.8.4.4 If the alleged violation explained in the alert notice has not been corrected to the satisfaction of the Authority's workforce compliance inspector issuing the notice within three business days after it is received by the Contractor, the workforce compliance inspector shall issue a violation notice to the Contractor. Said violation notice shall explain, in sufficient detail, the facts of the continuing violation.

16.8.4.5 After issuing a notice of violation, the Authority's workforce compliance inspector shall notify the alleged violator that it shall submit, within seven business days, a written statement explaining why it is not in violation of this subchapter or the affirmative action plan or an explanation of how it will correct any such violation. The written statement shall be reviewed by the Director. If the Director determines that the violator has not adequately explained why it is not in violation or determines that the violation is continuing to occur, then said Director shall conduct an investigatory conference to determine whether there is a violation and/or if corrective measures must be taken. The conference may also be conducted to discuss and resolve issues before taking any action pursuant to Section 16.8.6 below. Such investigatory conference shall be conducted within 30 business days of the contractor's submission of its written statement. The Director may conduct interviews and request from appropriate parties the submission of additional information as is considered necessary to determine whether the alleged violation has occurred.

16.8.5 Affirmative Action and Small Business Compliance.

16.8.5.1 The Contractor shall designate an employee who shall serve as a liaison with the Authority's workforce compliance inspector and who shall be responsible for coordinating the firm's affirmative action program, maintaining all records required by this chapter and submitting the forms required by this chapter through the Authority's website, or as otherwise directed, to the Authority's designated employee or representative

16.8.5.2 The Contractor shall complete and submit the following forms available from the Authority, at the times indicated, and in the manner and form (whether hard-copy or electronic) specified by the Authority:

(a) An initial project workforce report, Form AA-201, upon notification of award, and prior to the Authority's execution of a construction contract;

(b) A monthly project workforce report, Form AA-202, submitted in electronic form no later than the seventh business day of each month for the duration of the contract; and

(c) A certified payroll report within 10 days of the end of each pay period.

16.8.6 Sanctions

16.8.6.1 If the Authority determines that the Contractor is in violation of the Authority's affirmative action regulations, or the terms of this Agreement, or its affirmative action plan, the Authority shall enforce the aforesaid obligations and the requirements of the affirmative action plan by any or all of the following actions:

(a) Reduce the Contractor's compensation by a maximum of one and one-half percent of the contract price if the contractor is found not to have in good faith satisfied the hiring requirements set forth in the contract. This reduction in the contract price may be effectuated either by the withholding of all or part of future payments to the Contractor or by a reduction in the amount of retainage otherwise due for release to the contractor under the contract; or

(b) Terminate this Agreement.

16.9 MBE/WBE/DBE/SBE/VBE Project Inclusion

The Contractor is strongly encouraged to maximize the use, employment and inclusion of Union County MBE/WBE/DBE/SBE/VBE and non-Union County MBE/WBE/DBE/SBE/VBE contractors/ subcontractors/businesses/vendors/suppliers and make good faith efforts to encourage meaningful participation of the aforementioned in the Project.

16.9.1 Other MBE/WBE/DBE/SBE/VBE Obligations

The Contractor shall ensure that each contractor and subcontractor performing Work on the Contract shall undertake or continue existing EEO programs to ensure that minority group members and women are afforded equal employment opportunities without discrimination because of race, creed, color, national origin, sex, age, disability or marital status.

The Contractor shall submit an EEO policy statement to the Authority for each of its contractors/subcontractors/businesses/vendors/suppliers, as applicable within twenty (20) days of entering into a contract with the business.

16.10 Anti-Trust.

16.10.1 The Contractor, by executing this Agreement, does hereby warrant and represent that this Agreement has not been solicited, secured or prepared, directly or indirectly, in a manner contrary to the laws of the State, and that said laws have not been violated and shall not be violated as they relate to the procurement or the performance of the Work by any conduct, including the paying or giving of any fee, commission, compensation, gift, gratuity, or consideration of any kind, direct or indirect, to any employee or officer of the Authority.

16.10.2 The penalty for breach or violation of this Section may, at the sole option of the Authority, result in: (i) the termination of this Agreement without the Authority being liable for damages, costs and/or attorney fees, and/or (ii) a deduction from the payments to be made by the Authority pursuant to this Agreement of the full amount of such commission, percentage, brokerage or contingent fee.

16.11 Anti-Collusion. By executing this Agreement, the Contractor hereby warrants and represents that (1) this Agreement has not been executed in the interest of or on behalf of any undisclosed person, partnership, company, association, organization, or corporation; (2) that the Contractor's bid for the Project was genuine and not collusive or a sham; (3) that the Contractor has not directly or indirectly induced or solicited any other individual or firm to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived or agreed with any individual or firm or anyone else to put in a false or sham bid; (4) that the Contractor has not in any manner, directly or indirectly, sought by agreement, communication or conference with anyone to fix the bid price of the Contractor or of any other individual or firm or to fix any overhead, profit, or cost element of such bid price; (5) that all statements of the Contractor are true; and (6) that the Contractor has not directly or indirectly, submitted a bid price or any breakdown thereof, divulged information or data relative thereto, paid any fee in connection therewith to any corporation, partnership, company, association, organization, bid depository, or any member or agent thereof.

16.12 Conflicts of Interest.

16.12.1 The Contractor shall not pay, offer to pay, or agree to pay, either directly or indirectly, any fee, commission, compensation, gift, gratuity or other thing of value of any kind to: (i) an Authority officer or employee with which the Contractor transacts, or offers or proposes to transact, business; or (ii) any member of the immediate family (defined by N.J.S.A. 52:13D-13(i)) of any such Authority officer or employee; or (iii) any partnership, firm or corporation with which such Authority officer or employee is employed or associated, or in which such officer or employee has an interest within the meaning of N.J.S.A. 52:13D-13(g).

16.12.2 The solicitation from the Contractor of any fee, commission, compensation, gift, gratuity or other thing of value by any Authority officer or employee shall be reported in writing forthwith by the Contractor to the State Attorney General.

16.12.3 The Contractor shall not directly or indirectly undertake any private business, commercial or entrepreneurial relationship (whether or not pursuant to employment, contract or other agreement, express or implied) with, or sell any interest in the Contractor to, any Authority officer or employee having any duties in connection with the purchase, acquisition or sale of any property or services by or to the Authority; and shall not undertake any such relationship with, or sell any such interest to, any person, firm or entity with which such Authority officer or employee is employed or associated, or in which such Authority officer or employee has an interest within the meaning of N.J.S.A. 52:13D¬13(g). Any relationship subject to this provision shall be reported in writing to the State Attorney General.

16.12.4 The Contractor shall not influence, attempt to influence, or cause to be influenced any Authority officer or employee in such officer's or employee's official capacity in any manner that might tend to impair the objectivity or independence of judgment of said officer or employee.

16.12.5 The Contractor shall not cause or influence, or attempt to cause or influence, any Authority officer or employees to use or attempt to use such officer's or employee's official position to secure unwarranted privileges or advantages for the Contractor or any other person.

16.13 Risk of Loss Assumed by the Contractor.

16.13.1 Until Substantial Completion, the Contractor shall bear the risk of loss or damage to the permanent construction, temporary construction, and materials, whether the Contractor has received payment for such construction or materials.

16.13.2 The Contractor shall bear the risk of claims by third parties made against the Contractor or the Authority, on account of injuries (including wrongful death), loss, or damage of any kind whatsoever arising or alleged to arise out of or in connection with the performance of the Work. The risk of claims, whether or not actually caused by or resulting from the performance of the Work or out of or in connection with the Contractor's operations or presence at or in the vicinity of the Project Site or on Authority premises, and whether such injuries, loss, and damages are sustained, applies at any time both before and after Final Completion.

16.13.3 The Contractor shall bear the risk of loss or damage to any property of the Contractor, and of claims made against the Contractor or the Authority for loss or damage to any property of lessors, Subconsultants, Subcontractors, suppliers, workers, and others performing the Work. Said risk is assumed during all times prior to removal of the property from the Site.

16.14 Indemnification.

16.14.1 To the fullest extent permitted by law, the Contractor shall indemnify, protect, defend and save harmless the Authority, the CM, the Architect , as well as their respective agents, servants, officers, directors and employees, from and against any loss, damage, injury, cost or expense including interest, attorney’s fees and other expenses, and from and against any claim, demand, liability, lawsuit, judgment, action or other proceeding arising from, in connection with, or as a result of any of the following:

16.14.1.1 The negligent acts or omissions of the Contractor, its agents, servants, officers, employees, Subcontractors, Subconsultants or any other person acting at the Contractor's request, subject to its direction, or on its behalf;

16.14.1.2 The loss of life or property, or injury or damage to the person, body or property of any person or persons whatsoever, that arises or results directly or indirectly from the

negligent acts or omissions by the Contractor, its agents, servants, officers, employees, Subcontractors, Subconsultants or any other person acting at the Contractor's request, subject to its direction, or on its behalf;

16.14.1.3 Any gross negligence, default, or breach, of the Contractor, its agents, servants, officers, employees, Subcontractors, Subconsultants or any other person acting at the Contractor's request, subject to its direction, or on its behalf; and

16.14.1.4 Violation of or non-compliance with Federal, State, local and municipal laws and regulations, ordinances, building codes (including without limitation the Americans with Disabilities Act) arising from the performance or non-performance of, or arising out of conditions created or caused to be created by the Contractor, its agents, servants, officers, employees, Subcontractors, Subconsultants or any other person acting at the Contractor's request, subject to its direction, or on its behalf.

16.14.2 The Contractor's indemnification obligation is not limited by, but is in addition to, the insurance obligations contained in this Agreement.

16.14.3 The Contractor agrees that any acceptance by the Authority of the Work performed, and/or reports, plans or Specifications provided by the Contractor shall not operate to limit the obligations of the Contractor under this Agreement and that the Authority assumes no obligations to indemnify or hold harmless the Contractor, its agents, servants, employees, vendors, suppliers, Subcontractors or Subconsultants against any claims that may arise out of its performance or nonperformance under this Agreement. the Contractor also agrees that the provisions of this indemnification clause shall in no way limit the Contractor's obligations under this Agreement, nor shall they be construed to relieve the Contractor from any liability, nor preclude the Authority from taking any other actions available to it under any other provisions of this Agreement or otherwise at law or equity.

16.14.4 The provisions of this Section 16.14 shall survive the expiration or termination of this Agreement.

17.0 SUSPENSION OF SERVICES OR WORK

17.1 Authority's Right to Suspend Work. The Authority shall have the right to defer the Commencement Date or to suspend the whole, or any part, of the Work required under this Agreement whenever, in the sole discretion of the Authority, it is necessary or expedient for the Authority to do so. The Authority shall by notice to the Contractor suspend performance of the Work and upon receipt of such notice, unless otherwise directed in writing by the Authority, the Contractor shall immediately discontinue all Work, except as necessary to properly secure the Project.

17.2 Compensation. In the event of a suspension by the Authority pursuant to this Section, Compensation shall be determined as follows:

17.2.1 If the Authority determines that the Work have been suspended for a period cumulatively totaling less than forty-five (45) Days, there shall be no additional compensation paid to the Contractor.

17.2.2 If the Authority determines that the Work have been suspended for a period cumulatively totaling forty-five (45) Days or more, and if the Authority determines that the suspension has resulted from no fault of the Contractor, the Parties shall amend this Agreement to provide an adjustment to the Contract Price in an amount deemed proper by the Authority and the Contractor after a review of the Contractor's submissions relating to the increased costs actually incurred by the Contractor as a direct result of the suspension. No such adjustment to the Contract Price will change any of the other terms of this Agreement.

17.2.3 When the Authority has determined that a suspension is the fault of the Contractor, the Authority may, at its sole option, suspend all payments to the Contractor. Payment may be reinstated by the Authority upon completion of the Work in accordance with the other provisions of this Agreement, provided that there shall be no upward adjustment in direct or indirect costs or in any other costs. Alternatively, the Authority may terminate this Agreement pursuant to Section 18.2, or carry out the Work as provided for in Section 18.3.

17.3 Requirement to Secure the Site Upon Suspension of the Work. In the event that a suspension of Work is ordered under this Section, the Contractor shall perform all Work necessary to ensure the safety of the public, the Authority, the employees and guests of the Project School District, and to secure all of the completed and partially completed Work.

18.0 DEFAULT AND TERMINATION

Nothing contained in this Section shall limit the right of the Authority to recover any and all costs and damages resulting from the Contractor's failure to perform the Work in a satisfactory manner.

18.1 Events of Default.

18.1.1 The Contractor shall be in default under this Agreement upon the occurrence of any one or more of the following events or conditions ("Events of Default"), following notice and opportunity to cure (if applicable), as specified in Section 18.1.2.

(a) the Contractor fails to either (i) promptly begin the Work under the Contract Documents, or (ii) prosecute the Work in accordance with the Project Schedule;

(b) the Contractor fails to perform the Work in accordance with the Contract Documents;

(c) the Contractor refuses to remove and replace rejected materials or unacceptable Work;

(d) the Contractor disregards or otherwise fails to comply with all applicable Legal Requirements;

(e) the Contractor refuses or otherwise fails to properly staff the Project;

(f) the Contractor fails, absent a valid dispute, to make payments to vendors, suppliers, Subcontractors or Subconsultants for materials, labor or services in accordance with the respective agreements between the Contractor and its vendors, suppliers, Subcontractors and/or Subconsultants;

(g) the Contractor fails to maintain or produce any Deliverables or other records required by the Contract Documents to be so maintained or produced;

(h) the Contractor fails to cooperate with the Authority where such cooperation is deemed necessary by the Authority for the implementation of this Agreement;

(i) the Contractor fails to obtain and properly maintain the level of insurance coverages outlined in this Agreement;

(j) the Contractor fails to obtain and properly maintain the level of bonding outlined in this Agreement;

(k) the Contractor assigns or transfers its obligations, privileges or rights under this Agreement without the prior, written consent of the Authority;

(l) the Contractor makes any misrepresentation or conceals any material fact;

(m) the Contractor commences or has commenced against it any action under the United States Bankruptcy Code or any State or Federal insolvency law, the commencement of which, in the Authority's judgment, may effectively impair the ability of the Contractor to perform its obligations under this Agreement;

(n) the Contractor fails to discharge or obtain a stay of any judgment or order for the payment of money arising out of the prosecution of the Work (provided that for purposes hereof, posting of a bond in the amount of 124% of such judgment or order shall be deemed an effective stay);

(o) the Contractor fails to comply with a Directive or Contract Change Directive issued by the Authority;

(p) the Contractor fails to perform Work as required under this Agreement or the Contract Documents; or

(q) the Contractor otherwise violates or breaches this Agreement, the Contract Documents or any material provision or term thereof.

18.1.2 The Authority shall provide the Contractor and its surety with written notice of the Contractor's default ("Notice of Default"). For all such Events of Default except those contained in subsections 18.1.1 (m) and 18.1.1 (n) (and any such default that by its nature cannot be cured), the Contractor may, within seven (7) Days of receipt of the Notice of Default, commence correction of such default, neglect or violation, with diligence and promptness, fully curing the same within the time prescribed by the Authority, if any, within the Notice of Default. If the Contractor's default is capable of cure, but by its nature, cannot be cured within seven (7) Days, such additional period of time shall be allowed as may reasonably be necessary to cure the default, provided that the Contractor or its surety commences such cure within such seven (7) Day period and thereafter diligently prosecutes such through completion. Failure of the Contractor to commence correction of its default, neglect or violation within seven (7) Days of receipt of the Notice of Default, or to cure the same within the time prescribed by the Authority, shall allow the Authority to issue a Notice for Termination for Cause as per Section 18.2 of this Agreement.

18.2 Termination for Cause.

18.2.1 If any default described in Section 18.1 above is not subject to cure or is not cured within the period specified in 18.1.2, the Authority may terminate this Agreement for cause. Any such Termination for Cause shall be effected by delivery of a "Notice of Termination for Cause" to the Contractor and its surety specifying the extent to which the Work under this Agreement are terminated and the date upon which such termination shall become effective.

18.2.2 Upon Termination for Cause by the Authority pursuant to this Section, the Authority may, without prejudice to any other rights or remedies of the Authority, complete the Work that were required to be performed by the Contractor by whatever methods the Authority may deem appropriate.

18.2.3 In the event this Agreement is terminated for cause pursuant to this Section 18.2, the Authority reserves the right not to make any further payments to the Contractor and may require the Contractor to repay all or a portion of the monies already paid. The Contractor, at its own expense, shall be obligated to take any steps necessary to enable the Authority to complete the Work itself, or for the Authority to engage another contractor, design professional or the Contractor to complete the Work. Such steps may include, but are not limited to, the prompt delivery to the Authority of all Deliverables, Documents and Work Product identified herein and/or related to the Project. If the payments then or thereafter due the Contractor are not sufficient to cover the Authority's cost to complete the Work itself or engage another contractor, design professional or the Contractor to complete the Work, the Contractor shall pay the difference to the Authority upon demand.

18.2.4 No action by the Authority pursuant to this Section shall operate to waive or release any claims that the Authority may have against the Contractor under this Agreement.

18.3 The Authority's Right to Complete the Work

18.3.1 If the Contractor fails to perform any obligation imposed under this Agreement and the Contract Documents within seven (7) Days after receipt of written notice to commence and continue correction of such failure with diligence and promptness, the Authority may take steps to remedy such failure without prejudice to any other remedy the Authority may have. In such case, an appropriate written notice shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such failure, including Compensation for any additional work or services of other contractors and/or Professional Services Consultants engaged as a result of such failure. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Authority upon demand.

18.3.2 Any action by the Authority under this Section shall be without prejudice to the Authority's rights under this Agreement and shall not operate to release the Contractor from any of its obligations under this Agreement or the Contract Documents.

18.4 Termination for Convenience of the Authority.

18.4.1 Performance by the Contractor of its obligations under the Contract Documents may be terminated by the Authority in whole or in part, whenever the Authority, in its sole discretion, determines that such termination is in its best interest. Such a termination shall be called a "Termination for Convenience."

18.4.2 Any such Termination for Convenience shall be effected by delivery of a "Notice of Termination for Convenience" specifying the extent to which the Work under this Agreement are terminated and the date upon which such termination becomes effective.

18.4.3 Upon such Termination for Convenience, the Contractor shall be entitled to Compensation for the Work actually and satisfactorily performed by the Contractor, less payments previously made. the Contractor shall also be entitled to the reasonable costs and expenses attributable to such Termination for Convenience.

18.4.4 Upon a Termination for Convenience, the Contractor shall furnish to the Authority, free of charge, such closeout reports, Documents, and materials as may be reasonably required by the Authority. Materials purchased by the Contractor for the Project that have not yet been incorporated into the Work may, at the option of the Authority, be purchased from the Contractor at the actual cost and delivered to a prescribed location or otherwise disposed of as mutually agreed.

18.4.5 Within sixty (60) Days of the effective termination date, the Contractor shall submit to the Authority claims for any costs that were incurred but that are not subject to payment pursuant to this Section 18.4 or any other provision of the Contract Documents. No claim will be allowed for anticipated profits on Work that have not been performed. the Contractor's failure to submit a claim to the Authority within sixty (60) Days of the effective termination date shall constitute a waiver of any and all claims pursuant to this Section 18.4.

19.0 CLAIMS

All Claims by the Contractor against the Authority shall be governed by the following provisions.

19.1 General. All Claims asserted by the Contractor against the Authority shall be subject to the New Jersey Tort Claims Act, N.J.S.A. 59:1-1 et seq.

19.2 Notice of Claim. The Contractor shall file notice of its Claim on a form provided by the Authority, which form shall be completed in its entirety and signed by the Contractor. Incomplete forms will be rejected and have no effect.

19.3 False Claims Liability. The Contractor shall be held liable and subject to all penalties and damages under the New Jersey False Claims Act, N.J.S.A. 2A:32C¬1 et seq., for any false or fraudulent Claim submitted to the Authority.

19.4 Review of Claims. The administrative process for review of Claims is sequential in nature and mandatory. The Authority's Claims procedure is composed of the following steps:

Step One: Review by the Authority

Step Two: Non-binding Mediation

Completion of the two (2) steps of Claims review is a mandatory prerequisite to the initiation of litigation by either Party.

19.5 Compliance with Claim Review Procedure. Each Claim will begin its review at Step One. A Claim will not proceed to the next step unless the Contractor submits a written objection to the prior step and requests that its Claim proceeds to the next step. If at any step in the process a Claim is resolved, the Contractor must sign a full and final release as to any and all matters arising from the Claim.

19.6 Step One: The Authority's Review.

19.6.1 The Contractor must provide to the CM and the Authority the required forms as required by this Section in order to begin the Authority's administrative process for the review of Claims. the Contractor shall also submit to the Authority all documentation supporting the Contractor's Claim. The documentation provided to the Authority will serve as the basis for evaluation of the Contractor's

position regarding the Claim throughout Step One of the administrative process. the Contractor shall submit additional information upon request by the Authority. No formal action will be taken by the Authority unless and until the Authority receives complete Claim documentation from the Contractor.

19.6.2 Authority Review and Decision. At the option of the Authority, a meeting may be scheduled with the Contractor, the Authority and the CM to discuss the Claim. The Authority shall render its decision regarding the Claim in writing within thirty (30) Days of the receipt of the required forms and all supporting documentation or within thirty (30) Days of any meeting with the Contractor, the Authority and the CM, whichever is later. This time limit may be extended by mutual agreement of the Parties. the Contractor, within fifteen (15) Days of the receipt of the decision by the Authority, shall accept or reject the Authority's decision in writing. If the Contractor neither accepts nor rejects in writing the Authority's decision within fifteen (15) Days, the Claim will be considered withdrawn from the administrative process and there will be no further administrative remedy available to the Contractor for the subject Claim.

19.7 Step Two: Non-Binding Mediation. If the Contractor rejects in writing the decision of the Authority, there is no further automatic administrative review of the Claim. Within fifteen (15) Days after issuance of a Certificate of Occupancy or Certificate of Acceptance for this Project, the Contractor may request in writing that any or all outstanding Claims regarding this Project, which include any or all Claims that have been processed through Step One of the Claim resolution process, and that were neither withdrawn nor considered withdrawn from the process be submitted to Step Two, non-binding mediation. Such request shall be sent to the Authority and shall specifically identify which Claim(s) are to be submitted to Step Two. Any Claim not specifically identified shall be deemed withdrawn. No Claim will proceed automatically to Step Two and the Contractor must make a specific written request that the Claim be elevated to Step Two. Step Two will not be available until after the issuance of a Certificate of Occupancy or Certificate of Acceptance, unless an earlier time for submission of the Claim to Step Two is agreed to by the Contractor and the Authority. The cost of non-binding mediation shall be shared equally by the Contractor and the Authority. The mediator shall be selected by the Authority, with the concurrence of the Contractor. The rules for the mediation shall be agreed to by the Authority, the Contractor and the mediator prior to the start of the mediation. The mediation will not proceed, however, if the Parties fail to agree on the rules for the mediation, in which case Step Two will be deemed complete.

20.0 REPRESENTATIONS

The Contractor hereby represents as follows:

20.1 The Contractor is financially solvent, can pay its debts when due, and possesses sufficient working capital to complete the Work required and perform its obligations under this Agreement and the Contract Documents.

20.2 The Contractor is professionally qualified for the Project, and has the capability and experience, including sufficient qualified and competent personnel, to efficiently and timely perform the Work. The Contractor will continuously furnish sufficient personnel to perform the Work in a timely and proper manner.

20.3 The Contractor is experienced, authorized to do business in the State of New Jersey and is properly licensed by all necessary governmental and public and quasi-public authorities having jurisdiction over the Contractor and the Work it will be performing. The Contractor shall ensure that all of its employees, vendors, suppliers, Subcontractors and Subconsultants performing Work for this Project have such licenses and certificates.

20.4 The Contractor's execution of this Agreement and its performance hereunder is within its duly authorized powers.

20.5 The Contractor certifies that it has investigated the conditions of the Project and that it fully understands the conditions of the Project and its obligations pursuant thereto. The Contractor agrees that it will not make any Claim for, or be entitled to, cancellation or relief from the Contract Documents without penalty because of its misunderstanding or lack of information related to the conditions of the Project and its obligations pursuant thereto.

20.6 The Contractor certifies that all representations made by it in this Agreement or any of the Contract Documents are true, subject to penalty of law. The Contractor understands and agrees that its knowing or intentional violation of any statute or regulation related to public contracts and/or its misrepresentation or concealment of any material fact may be cause for termination of this Agreement. The Contractor understands and agrees that the Contractor's violation of any statute or regulation related to public contracts and/or its misrepresentation or concealment of any material fact shall serve as a legal bar to the Contractor's enforcement of its rights under this Agreement and the Contract Documents, including any and all Claims at law or equity.

20.7 The Contractor is currently pre-qualified as a General Contractor and properly registered pursuant to The Public Works Contractor Registration Act, N.J.S.A. 34:11-56.48 et seq.

20.8 The Contractor and all of its Subcontractors and Subconsultants have provided to the Authority proof of valid business registration with the Division of Revenue of the New Jersey Department of the Treasury, pursuant to N.J.S.A. 52:32-44. The Contractor shall not enter into any subcontract with a Subcontractor or Subconsultant that has not provided it and the Authority with proof of such valid business registration.

20.9 The Contractor assumes full responsibility to the Authority for the acts and omissions of its officers, employees, agents, Subcontractors, Subconsultants, and others employed or retained by it in connection with Work performed for the Project.

20.10 The representations and warranties enumerated in this Section operate in addition to, and shall in no way supersede, limit, or restrict any other duty, responsibility, representation, or warranty, express or implied, created or required by this Agreement or by law.

21.0 THE AUTHORITY'S RIGHTS

21.1 The Authority shall have the right to perform work related to the Project and to award contracts in connection with the Project that are not part of the Contractor's responsibilities under this Agreement or the Contract Documents.

21.2 The Authority shall have the right, in its sole discretion, to accept or reject employees and personnel proposed by the Contractor to work on the Project. The Contractor shall make a timely and prompt resubmittal to provide other employees or personnel to replace any that are rejected by the Authority.

21.3 The Authority shall have the right to remove any of the Contractor's employees from the Project at any time during the Term of this Agreement if that employee is deemed by the Authority not to be of the level of competence or ability required under this Agreement, or if said employee is for any reason found to be unsuitable to perform pursuant to this Agreement, as determined by the Authority in its sole discretion. In such case, the Contractor shall promptly submit the name and qualifications of a replacement.

21.4 The Authority shall have the right to evaluate the Contractor's performance pursuant to the Authority's Performance Evaluation Policy and Procedures. The Authority shall also have the right to consider the Contractor's evaluation as a factor used in the technical ranking of the Contractor with respect to any submission by the Contractor in response to future procurements by the Authority.

21.5 In addition to any of the other rights and remedies of the Authority specified in this Agreement, the Authority reserves the right to bring an action against the Contractor for any damages sustained by the Authority from any Work performed by the Contractor when such damage is occasioned by the negligent act, error, omission or willful misconduct of the Contractor.

21.6 The Authority's acceptance, use of or payment for all or any part of the Contractor's performance hereunder or in connection with the Project shall in no way alter the Contractor's obligations under this Agreement.

21.7 The Authority and any other State inspecting or oversight agencies having jurisdiction reserve the right to audit (or have their agents audit) the records of the Contractor in connection with all matters related to this Agreement. If, as a result of such audit, the Contractor is discovered for any reason to owe any money or refund to the Authority, the Authority may reduce the Contractor's Invoice amount to an amount considered commensurate with the actual Work performed.

21.8 The Authority or any other State inspecting, or oversight agencies have the right to request, and the Contractor agrees to furnish free of charge, all information and copies of all records, documents or books the Authority or any other State inspecting, or oversight agencies may request of the Contractor and its Subcontractors and Subconsultants. The Contractor and its Subcontractors and Subconsultants shall allow representatives of the Authority or any other State inspecting or oversight agencies to visit the office(s) of each periodically, upon reasonable notice, in order to review any information, records, Documents or books related to this Agreement or to otherwise monitor any Work being performed by the Contractor and its Subcontractors and Subconsultants pursuant to this Agreement and the Contract Documents.

22.0 2 CFR PART 200 APPENDIX II FEDERAL REQUIREMENTS

22.1 Domestic Preference for Procurements. Pursuant to N.J.S.A. 52:32-1, if manufactured items or farm products will be provided under this Contract to be used in a public work, they shall be manufactured or produced in the United States and the Contractor shall be required to so certify.

Consistent with 2 C.F.R. § 200.322, as appropriate, and to the extent consistent with law, the Contractor should, to the greatest extent practicable, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States. This includes, but is not limited to iron, aluminum, steel, cement, and other manufactured products. For purposes of this clause: (i) Produced in the United States means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States; and (ii) Manufactured products mean items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

22.2 Clean Air Act. The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the federal Clean Air Act, as amended, 42 U.S.C. § 7401 et seq. The Contractor agrees to report each violation to the Authority and understands and agrees that the Authority will, in turn, report each violation as required to the appropriate Environmental Protection Agency Regional Office. The Contractor also agrees to include these requirements in each subcontract exceeding $150,000 financed in whole or in part with federal assistance.

22.3 Federal Water Pollution Control Act. The Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the federal Water Pollution Control Act, as amended, 33 U.S.C. § 1251 et seq. The Contractor agrees to report each violation to the Authority and understands and agrees that the Authority will, in turn, report each violation as required to the appropriate Environmental Protection Agency Regional Office. The Contractor also agrees to include these requirements in each subcontract exceeding $150,000 financed in whole or in part with federal assistance.

22.4 Solid Waste Disposal Act. In the performance of this Contract, the Contractor shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot

be acquired– (i) Competitively within a timeframe providing for compliance with the Contract performance schedule; (ii) Meeting Contract performance requirements; or (iii) At a reasonable price. Information about this requirement, along with the list of EPA-designated items, is available at EPA's Comprehensive Procurement Guidelines webpage: https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program. The Contractor also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

22.5 Compliance with the Copeland "Anti-Kickback" Act 40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3) (the "Act"). The Contractor shall comply with the Act. The Contractor shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of the Work, to give up any part of the compensation to which he or she is otherwise entitled.

22.6 Contract Work Hours and Safety Standards Act (40 U.S.C. 3701–3708) (the "Act"). The Contractor shall comply with the provisions of 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5), with respect to the employment of mechanics or laborers. Under 40 U.S.C. 3702 of the Act, Contractor is required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

22.7 Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment. The Contractor shall comply with the prohibition on certain telecommunications and video surveillance services or equipment in accordance with the provisions of CFR 200.216 to the extent same may be incorporated into a new building structure and/or acquired /required by the Contractor or subcontractor for use during the construction process.

23.0 MISCELLANEOUS

23.1 Notices. All notices or other communications required by this Agreement shall be in writing and sent by certified mail, return receipt requested, postage prepaid or by Federal Express or similar guaranteed overnight courier and shall be deemed delivered on the day after the notice or other communications was deposited in the mail or with such overnight courier. Notices shall be addressed as directed in Appendix A.

23.2 Incorporation by Reference. This Agreement incorporates by reference, as if set forth herein, all of the Documents constituting this Agreement in their entirety, including but not limited to, the Contract Documents, any appendices to this Agreement, and the RFB and any Amendments or addenda thereto.

23.3 Conflict in Terms. In the event of a conflict, discrepancy or inconsistency between or among the Contract Documents, interpretation will be based on the following descending order of priority:

1. This Agreement, and Change Orders hereto
2. Appendix A (Special Conditions)
3. The Specifications
4. The Architect's Documents
   (a) Drawings – Large Scale
   (b) Drawings – Small Scale

In the event there is any conflict between and among the requirements contained in this Agreement, the Contractor will provide the higher quality level of service and Work or meet the higher standard, as determined by the Authority in its sole discretion

23.4 Changes to Agreement. Any change to this Agreement must be made in writing in the form of a Change Order executed by the Contractor and the Authority. Any Work performed by the Contractor without a Change Order or Contract Change Directive that differ from, or are in addition to, the Work required by this Agreement, shall be done at the Contractor's own financial risk.

23.5 No Waiver of Warranties or Legal/Equitable Remedies. Nothing in this Agreement shall be construed to be a waiver by the Authority of any warranty, expressed or implied, or any remedies at law or equity, except as specifically and expressly stated in a writing by the Authority.

23.6 State Sales Tax. Materials, supplies or services for exclusive use in erecting the structures or buildings or otherwise improving, altering or repairing any such component of the Work on the Project, pursuant to the Contract Documents are exempt from New Jersey State Sales Tax. Purchases or rentals of equipment are not exempt from any tax under the State Sales Tax Act.

23.7 Procedural Requirements. The Contractor shall comply with all written procedural instructions that may be issued from time to time by the Authority.

23.8 Governing Law. This Agreement, and any and all litigation arising therefrom or related thereto shall be governed by the applicable laws, regulations and rules of the State of New Jersey without reference to conflict-of-laws principles.

23.9 Forum and Venue. Any legal action to resolve a dispute or Claim filed under the terms of this Agreement shall be brought only in a state court in the State of New Jersey.

23.10 Time is of the Essence. All time limits as stated in this Agreement are of the essence.

23.11 Severability. In the event that any provision of this Agreement shall be held invalid or unenforceable by a court of competent jurisdiction, such holding shall not invalidate or render unenforceable any other provision hereof.

23.12 Waiver of Breach. In the event that any provision of this Agreement should be breached by either party and such breach is thereafter waived by the other party, such waiver shall be limited to the particular breach so waived and shall not be deemed to waive any other breach. Any consent by the Authority to a delay in the Contractor's performance of any obligation shall apply only to the particular obligation or transaction to which it relates, and it shall not apply to any other obligation or transaction. Any delay in the Authority's enforcement of any remedy in the event of a breach by the Contractor of any term or condition of this Agreement or any delay in the Authority's exercise of any right under this Agreement shall not be construed as a waiver.

23.13 Negotiated Agreement. This Agreement was negotiated between the Parties and shall be construed in accordance with its plain meaning, without giving any effect to any implication or inference arising from the fact that it may have been drafted by or on behalf of any party to this Agreement.

23.14 Peer Review. The Authority may, at its sole discretion, provide all or a portion of the Documents or other items prepared by the Contractor to other professionals for review and comment.

23.15 Execution in Counterparts. This Agreement, where applicable, may be executed simultaneously in one or more counterparts, each of which shall be deemed an original, and all of which shall constitute but one and the same instrument.

23.16 New Jersey Office of State Comptroller. The Contractor shall maintain all documentation related to products, transactions or services under this contract for a period of five (5) years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request.

23.17 Security Clearance. The Contractor and its personnel, and its Subconsultants, Subcontractors, and their personnel, shall be subject to such security clearance at the Project as the Authority may require.

ATTACHMENT A

SPECIAL CONDITIONS

A.1 Project Description:

See attached Project Description

A.2 Schedule: [675] calendar Days

A.3 Substantial Completion shall be achieved no later than [675] calendar Days after the Commencement Date.

A.4 Construction Management Firm (CM): [MAST Construction Services]

A.5 Other Professional Services Consultants:
[The DIGroup Architecture]

A.6 Notices shall be addressed as follows:

Authority:

Union County Improvement Authority
10 Elizabethtown Plaza, 5th Floor
Elizabeth, New Jersey 07207
Attention: Dr. Bibi Taylor, Executive Director

The Contractor:

Attention: [ ]

Name of Project

Renovation & Addition of the Union College of Union County Physical Education Center

(Project Description)

Union College is proposing to expand their outdated Physical Education Center to fulfill its continuing need to provide a collegiate level competitive sport and recreational venue with allied physical educational and support spaces on their Cranford, NJ main campus. The project consists of an addition and renovation at the southwest end of their main campus building. The footprint of the addition is 33,150 sf, consisting of a new gymnasium to replace the undersized, high school level gym currently being utilized along with a weight room, visiting team locker room, therapy rooms and the athletic success educational program classroom. The second floor of the addition is 1,900 sf, consisting only of an egress corridor from the existing second floor building, stair and electric room. The remainder of the athletic spaces that exists in the current building will be renovated to provide locker rooms for men and women, adequate office space for program management and sports officials, e-sports gaming competition area; wrestling room; sports education training rooms and adequate storage and support areas.

ATTACHMENT B

INSURANCE CERTIFICATES & BUSINESS REGISTRATION CERTIFICATE

(See attached sheets)

ATTACHMENT C

THE CONTRACTOR'S EMPLOYEES, SUBCONTRACTORS AND SUBCONSULTANTS

(See attached sheets)

APPENDIX C

PROJECT LABOR AGREEMENT

PROJECT LABOR AGREEMENT
COVERING CONSTRUCTION OF THE RENOVATION & ADDITION OF THE UNION COLLEGE OF UNION COUNTY PHYSICAL EDUCATION CENTER in CRANFORD, NEW JERSEY

ARTICLE 1 – PREAMBLE

WHEREAS, General Contractors and/or Project Management Firms, on behalf of themselves, and reflecting the objectives of Union County Improvement Authority as Owner, desire to provide for the efficient, safe, quality, and timely completion of THE RENOVATION & ADDITION OF THE UNION COLLEGE OF UNION COUNTY PHYSICAL EDUCATION CENTER in CRANFORD, NEW JERSEY (the "Project"), in a manner designed to afford lower reasonable costs to Union County Improvement Authority, the Owner, and the Public it represents, and the advancement of public policy objectives;

WHEREAS, this Project Labor Agreement will foster the achievement of these goals, inter alia by:

(1) ensuring a reliable source of skilled and experienced labor;

(2) standardizing the terms and conditions governing the employment of labor on the Project;

(3) permitting wide flexibility in work scheduling and shift hours and times; from those which otherwise might obtain;

(4) receiving negotiated adjustments as to work rules and staffing requirements from those which otherwise might obtain;

(5) providing comprehensive and standardized mechanisms for the settlement of work disputes, including those relating to jurisdiction;

(6) avoiding the costly delays of potential strikes, slowdowns, walkouts, picketing and other disruptions arising from work disputes, and promote labor harmony and peace for the duration of the Projects.

(7) furthering public policy objectives as to improved employment opportunities for minorities, women and the economically disadvantaged in the construction industry; expediting the construction process; and

WHEREAS, the signatory Unions desire the stability, security and work opportunities afforded by a Project Labor Agreement; and

WHEREAS, the Parties desire to maximize Project safety conditions for both workers and the public.

NOW, THEREFORE, the Parties enter into this Agreement:

SECTION 1. PARTIES TO THE AGREEMENT

This is a Project Labor Agreement ("Agreement") entered into by and between General Contractors and or Project Management Firm to be named, and their successors and assigns, for the Project's construction work to be performed on the property of Union County Improvement Authority in the State of New Jersey and by the Union County Building and Construction Trades Council, AFL-CIO, on behalf of itself and its affiliates and members, and the signatory Local Unions on behalf of themselves and their members.

ARTICLE 2 - GENERAL CONDITIONS

SECTION 1. DEFINITIONS

Throughout this Agreement, the Union party and the Building Trades Council are referred to singularly and collectively as "the Union(s)" where specific reference is made to "Local Unions" that phrase is sometimes used; the term "Contractor(s)" shall include the General Contractor (GC), Project Management Firms (PMF), and all signatory contractors, and their subcontractors of whatever tier, engaged in on-site Project construction work within the scope of this Agreement as defined in Article III; Union County Improvement Authority is referenced as (Owner); the Union County Building and Construction Trades Council, AFL-CIO is referenced as the BTC, and the work covered by this Agreement (as defined in Article III) is referred to as the "Project".

SECTION 2. CONDITIONS FOR AGREEMENT TO BECOME EFFECTIVE

The Agreement shall not become effective unless executed by the BTC and the GC and/or PMF and will remain in effect until the completion of the Project or until [ ], whichever is later.

SECTION 3. ENTITIES BOUND & ADMINISTRATION OF AGREEMENT

This Agreement shall be binding on all signatory Unions and the General Contractor and/or the Project Management Firm and all signatory Contractors performing on-site Project work, including site preparation and staging areas, as defined in Article 3. The Contractors shall include in any subcontract that they let, for performance during the term of this Agreement, a requirement that their subcontractors, of whatever tier, become signatory and bound by this Agreement with respect to subcontracted work performed within the scope of Article 3 and execute the Letter of Assent attached as Schedule B. This Agreement shall be administered by the GC and/or PMF on behalf of all Contractors.

SECTION 4. SUPREMACY CLAUSE

This Agreement, together with the local Collective Bargaining Agreements appended hereto as *Schedule A* represents the complete understanding of all signatories and supersedes any national agreement, local agreement or other collective bargaining agreement of any type which would otherwise apply to this Project, in whole or in part, except for all work performed under the NTD Articles of Agreement, the National Stack/Chimney Agreement, the National Cooling Tower Agreement, all instrument calibration work and loop checking shall be performed under the terms of the UA/IBEW Joint National Agreement for Instrument an Control Systems Technicians, and the National Agreement of the International Union of Elevator Constructors, with the exception of Article VII, IX and X of this Project Agreement, which shall apply to such work. Where a subject covered by the provisions, explicit or implicit, of this Agreement is also covered by a Schedule A, the provisions of this Agreement shall prevail. It is further understood that neither the GC nor any Contractor shall be required to sign any other agreement as a condition of performing work on this Project. No practice, understanding or agreement between a Contractor and Local Union, which is not explicitly set forth in this Agreement, shall be binding on this Project unless endorsed in writing by the GC.

SECTION 5. LIABILITY

The liability of any Contractor and the liability of any Union under this Agreement shall be several and not joint. The GC and/or PMF and any Contractor shall not be liable for any

violations of this Agreement by any other Contractor and the BTC and Local Unions shall not be liable for any violations of this Agreement by any other Union.

SECTION 6. THE GENERAL CONTRACTOR OR PROJECT MANAGEMENT FIRM

The GC and/or PMF shall require in its bid specifications for all work within the scope of Article 3 that all successful bidders, and their subcontractors of whatever tier, become bound by, and signatory to, this Agreement. Union County Improvement Authority is not a party to and shall not be liable in any manner under this Agreement. It is understood that nothing in this Agreement shall be construed as limiting the sole discretion of Union County Improvement Authority in determining which Contractors shall be awarded contracts for Project work. It is further understood that Union County Improvement Authority has sole discretion at any time to terminate, delay or suspend the work, in whole or part, on this Project.

SECTION 7. AVAILABILITY AND APPLICABILITY TO ALL SUCCESSFUL BIDDERS

The Unions agree that this Agreement will be made available to, and will fully apply to any successful bidder for Project work who becomes signatory thereto, without regard to whether that successful bidder performs work at other sites on either a union or non-union basis and without regard to whether employees of such successful bidder are, or are not, members of any unions. This Agreement shall not apply to the work of any Contractor or GC and/or PMF, which is performed at any location other than a Project site, as defined in Article 3, Section 1.

ARTICLE 3 - SCOPE OF THE AGREEMENT

The Project work covered by this Agreement shall be as defined and limited by the following sections of this Article.

SECTION 1: THE WORK

This Agreement shall apply to all on-site public construction work, including site preparation, demolition and hazardous waste remediation, for the Owner performed on the Project construction:

The scope of work is confined to the on-site Project work contained in the scope of the final construction contract of the General Contractors and/or PMFs awarded work.

SECTION 2. EXCLUDED EMPLOYEES

The following persons are not subject to the provisions of this Agreement, even though performing work on the Project:

A. Superintendents, supervisors (excluding superintendents and general supervisors and forepersons specifically covered by a craft's Schedule A), engineers, inspectors and testers (excluding divers specifically covered by a craft's Schedule A), quality control/assurance personnel, timekeepers, mail carriers, clerks, office workers, messengers, guards, non-manual employees, and all professional, engineering, administrative and management persons;

B. Employees of Owner or any State agency, authority or entity or employees of any municipality or other public employer;

C. Employees and entities engaged in off-site manufacture, modifications, repair, maintenance, assembly, painting, handling or fabrication of project components, materials, equipment or machinery, unless such offsite operations are covered by the New Jersey Prevailing Wage Act (for example, by being dedicated exclusively to the performance of the public works contract or building project and are adjacent to the site of work), or involved in deliveries to and from the Project site, excepting local deliveries of all major construction materials including fill, ready mix concrete and cement, asphalt and other items which are covered by this Agreement. Provided, however, local deliveries of ready mix, concrete, cement and asphalt shall not be contracted except to a subcontractor who pays wages and benefits not less than the economic equivalent of the wages and benefits set forth in Exhibit A.

D. Employees of the GC and/or PMF, excepting those performing manual, on-site construction labor who will be covered by this Agreement;

E. Employees engaged in on-site equipment warranty.

F. Employees engaged in geophysical testing (whether land or water) other than boring for core samples;

G. Employees engaged in laboratory or specialty testing or inspections;

H. Employees engaged in ancillary Project work performed by third parties such as electric utilities, gas utilities, telephone utility companies, and railroads.

SECTION 3. NON-APPLICATION TO CERTAIN ENTITIES

This Agreement shall not apply to the parents, affiliates, subsidiaries, or other joint or sole ventures of any Contractor or of GC and/or PMF, which do not perform work at this Project. It is agreed, for the purposes of this Agreement only, that this Agreement does not have the effect of creating any joint employment, single employer or alter ego status among the Owner, the GC and/or PMF and/or any Contractor. The Agreement shall further not apply to the Owner or any other state or county agency, authority, or other municipal or public entity and nothing contained herein shall be construed to prohibit or restrict the Owner or its employees of any other state authority, agency or entity and its employees from performing on or off-site work related to the Project. As the contracts which comprise the Project work are completed and accepted, the Agreement shall not have further force or effect on such items or areas except where inspections, additions, repairs, modifications, check-out and/or warranty work are assigned in writing (copy to Local Union involved) by the General Contractor and/or Project Management Firm for performance under the terms of this Agreement.

ARTICLE 4 - UNION RECOGNITION AND EMPLOYMENT

SECTION 1. PRE-HIRE RECOGNITION

The Contractors recognize the signatory Unions as the sole and exclusive bargaining representatives of all craft employees who are performing on-site Project work within the scope of this Agreement as defined in Article 3.

SECTION 2. UNION REFERRAL

A. The Contractors agree to hire Project, craft employees covered by this Agreement

through the job referral systems and hiring halls (where the referrals meet the qualifications set forth in items 1,2, and 4 subparagraph B) established in the Local Unions' area collective bargaining agreements (attached as Schedule A to this Agreement), subject to the goals of any applicable local ordinances or agreements pertaining to hiring and apprenticeship goals for minorities, women, residents of disadvantaged communities, and local residents.. Notwithstanding this, the Contractors shall have sole rights to determine the competency of all referrals; the number of employees required (except with regard to pile driving and cranes); the selection of employees to be laid-off (subject to the applicable procedures in Schedule A for permanent and/or temporary layoffs and except as provided in Article 5, Section 3); and the sole right to reject any applicant referred by a Local Union, subject to the show-up payments required in the applicable Schedule A. In the event that a Local Union is unable to fill any request for qualified employees within a 48-hour period after such requisition is made by the Contractor (Saturdays, Sundays, and holidays excepted), the Contractor may employ qualified applicants from another competent source. In the event that the Local Union does not have a job referral system, the Contractor shall give the Local Union first preference to refer applicants, subject to the other provisions of this Article. The Contractor shall notify the Local Union of the Project, craft employees hired within its jurisdiction from any source other than referral by the Union.

B. A Contractor may request by name, and the Local will honor, referral of persons who have applied to the Local for Project work and who meet the following qualifications as determined by a Committee of 3 designated, respectively, by the applicable Local Union, the GC and/or PMF and a mutually selected third party or, in the absence of agreement, the permanent arbitrator (or designee) designated in Article 7:

(1) possess any license required by NJ law for the Project work to be performed;

(2) have worked a total of at least 1000 hours in the Construction craft during the prior 3 years;

(3) were on the Contractor's active payroll for at least 60 out of the 180 calendar days prior to the contract award;

(4) have demonstrated ability to safely perform the basic function of the applicable trade.

Following the employment of the first employee in each craft under Schedule A or the procedure set forth above in paragraph A, no more than twelve (12%) per centum of the employees covered by this Agreement, per Contractor by craft, shall be hired through the special provisions above which, consistent with N.J.S.A. 52:38-4, permit contractors and subcontractors working on the public works project to retain a percentage of their current workforce (any fraction shall be rounded to the next highest whole number).

C. A certified MBE/WBE contractor may request from the Workforce Coordinator, through the GC and/or PMF, an exception to, and waiver of, the above per centum limitation upon the number of its employees to be hired through the special provision of Section2.B above. This exception is based upon hardship and demonstration by the contractor that the Project work would be the contractor's only job and that it would be obliged to lay off qualified minority and female employees in its current workforce moving from the last job. The exception and waiver are also conditioned upon the employees meeting the qualifications as set forth in Section 2.B above.

SECTION 3. NON-DISCRIMINATION IN REFERRALS

The Unions represent that their hiring halls and referral systems will be operated in a non-discriminatory manner and in full compliance with all applicable federal, state and local laws and regulations, which require equal employment opportunities. Referrals shall not be affected in any way by the rules, regulations, bylaws, constitutional provisions or any other aspects or obligations of union membership, policies or requirements and shall be subject to such other

conditions as are established in this Article. No employment applicant shall be discriminated against by any referral system or hiring hall because of the applicant's union membership, or lack thereof.

SECTION 4. WORKFORCE DIVERSITY

To the extent applicable, the parties hereby agree that each will implement and abide by the requirements of the Owner with regard to workforce diversity. Furthermore, General Contractor, Contractors and the Unions will comply with such affirmative action plan, including but not limited to: (1) the parties will not discriminate against any employee or applicant for employment because of age, race, color, creed, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality, sex. or any other protected category used by government regulation; (2) the parties will endeavor to include in any solicitations or advertisements for employees or subcontractors, a notice that all qualified applicants will receive consideration for employment, and contractors and subcontractors for work, without regard to age, race, color, creed, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality, sex. or any other protected category used by government regulation; and (3) the parties agree to utilize the best efforts to ensure that minority business enterprises and women-owned business enterprises shall have the maximum practicable opportunity to provide Construction Work under this Agreement.

The Local Unions agree and support the importance the Owner places on having and maintaining a diverse workforce. The Unions agree to refer any and all Union County Improvement Authority resident journeymen and apprentices who are registered on the Out-of-Work list of the local union referral systems at the time of a contractor's request. The Local Unions will cooperate with Contractor requests for residents of Union County Improvement Authority, residents of disadvantaged communities, minority, or women referrals to meet the requirements of the Owner.

In the event a Union either fails, or is unable, to refer qualified minority or female applicants in percentages equaling Project affirmative action goals as set forth in the Owners bid

specifications, the Contractor may employ qualified minority or female applicants from any other available source as Apprentice Equivalents. Apprentice Equivalents will have completed a DOL approved training program, applied to take a construction Apprenticeship test, and will be paid at not less then the applicable equivalent Apprentice rate. With the approval of the Local Administrative Committee (LAC), experience in construction related areas may be accepted as meeting the above requirements.

SECTION 5. CROSS AND QUALIFIED REFERRALS

The Unions shall not knowingly refer to a Contractor an employee then employed by another Contractor working under this Agreement. The Local Unions will exert their utmost efforts to recruit sufficient numbers of skilled and qualified craft employees to fulfill the requirements of the Contractor.

SECTION 6. UNION DUES / WORKING ASSESSMENTS

The union security provisions contained in the applicable Schedule A local agreements, shall not apply to the employees covered by this Agreement as for the period of time during which they are performing on-site Project work. No employee shall be discriminated against at the Project site because of the employee's union membership or lack thereof. In the case of unaffiliated employees who have voluntarily executed dues checkoff authorization cards provided in a Schedule A local agreement, the dues payment can be received by the Unions as a working assessment fee.

SECTION 7. CRAFT FOREPERSONS AND GENERAL FOREPERSONS

The selection of craft forepersons and/or general forepersons and the number of forepersons required shall be solely the responsibility of the Contractor except where otherwise provided by specific provisions of an applicable Schedule A. All forepersons shall take orders exclusively from the designated Contractor representatives. Craft foreperson shall be designated as working forepersons at the request of the Contractor, except when an existing local Collective Bargaining

Agreement prohibits a foreperson from working when the craftsperson he is leading exceed a specified number.

ARTICLE 5 - UNION REPRESENTATION

SECTION 1. LOCAL UNION REPRESENTATIVE

Each Local Union representing on-site Project employees shall be entitled to designate in writing (copy to General Contractor involved and/or Project Management Firm) representatives, including the Business Manager, who shall be afforded access to the Project.

SECTION 2. STEWARDS

A. Each Local Union shall have the right to designate a working journey person as a Steward and an alternate, and shall notify the Contractor and GC and/or PMF of the identity of the designated Steward (and alternate) prior to the assumption of such duties. Stewards shall not exercise supervisory functions and will receive the regular rate of pay for their craft classifications. There will be no non-working Stewards on the Project.

B. In addition to their work as an employee, the Steward shall have the right to receive complaints or grievances and to discuss and assist in their adjustment with the Contractor's appropriate supervisor. Each Steward shall be concerned with the employees of the Steward's Contractor and, if applicable, subcontractors of that Contractor, but not with the employees of any other Contractor. The Contractor will not discriminate against the Steward in the proper performance of Union duties.

C. The Stewards shall not have the right to determine when overtime shall be worked, or who shall work overtime, except pursuant to a Schedule A provision providing procedures for the equitable distribution of overtime.

SECTION 3. LAYOFF OF A STEWARD

Contractors agree to notify the appropriate Union 24 hours prior to the layoff of a Steward, except in cases of discipline or discharge for just cause. If a Steward is protected against layoff by a Schedule A, such provisions shall be recognized to the extent the Steward possesses the necessary qualifications to perform the work required. In any case in which a Steward is discharged or disciplined for just cause, the Local Union involved shall be notified immediately by the Contractor.

ARTICLE 6 - MANAGEMENT'S RIGHTS

SECTION 1. RESERVATION OF RIGHTS

Except as expressly limited by a specific provision of this Agreement, Contractors retain full and exclusive authority for the management of their Project operations including, but not limited to: the right to direct the work force, including determination as to the number to be hired and the qualifications therefore; the promotion, transfer, layoff of its employees; or the discipline or discharge for just cause of its employees; the assignment and schedule of work; the promulgation of reasonable Project work rules; and, the requirement, timing and number of employees to be utilized for overtime work. No rules, customs, or practices, which limit or restrict productivity or efficiency of the individual, as determined by the Contractor, GC and/or PMF, and/or joint working efforts with other employees shall be permitted or observed.

SECTION 2. MATERIALS, METHODS & EQUIPMENT

There shall be no limitations or restriction upon the contractors' choice of materials, techniques, methods, technology or design, or, regardless of source or location, upon the use and installation of equipment, machinery, package units, pre-cast, pre-fabricated, pre-finished, or pre-assembled materials, tool, or other labor-saving devices. Contractors may, without restriction, install or use materials, supplies or equipment regardless of their source. The on-site installation or application of such items shall be performed by the craft having jurisdiction over such work; provided, however, it is recognized that other personnel having special qualifications may

participate, in a supervisory capacity, in the installation, check-out or testing of specialized or unusual equipment or facilities as designated by the Contractor. Notwithstanding the foregoing statement of contractor rights, prefabrication issues relating to work traditionally performed at the job site shall be governed pursuant to the terms of the applicable Schedule A. There shall be no restrictions as to work, which is performed off-site for the Project, except for 1) offsite operations work covered under the New Jersey Prevailing Wage Act or 2) done in a fabrication center, tool yard, or batch plant dedicated exclusively to the performance of work on the Project, and located adjacent to the "site of work". Where available locally, offsite operations work covered under the New Jersey Prevailing Wage Act shall be performed within the territorial jurisdiction of the local unions signatory to this Agreement.

ARTICLE 7 - WORK STOPPAGES AND LOCKOUTS

SECTION 1. NO STRIKES-NO LOCKOUT

There shall not be strikes, sympathy strikes, picketing, work stoppages, slowdowns, hand billing, demonstrations or other disruptive activity at the Project for any reason by any Union or employee against any Contractor or employer while performing work at the Project. There shall be no other Union, or concerted or employee activity which disrupts or interferes with the operation of the existing free flow of traffic in the project area. Failure of any Union or employee to cross any picket line established by any union, signatory or non-signatory to this Agreement, or the picket or demonstration line of any other organization, at or in proximity to the Project site is a violation of this Article. There shall be no lockout at the Project by any signatory Contractor. Contractors and Unions shall take all steps necessary to ensure compliance with this Section 1 and to ensure uninterrupted construction and the free flow of traffic in the project area for the duration of this Agreement.

SECTION 2. DISCHARGE FOR VIOLATION

A Contractor may discharge any employee violating Section 1, above, and any such employee will not be eligible thereafter for referral under this Agreement for a period of 100 days.

SECTION 3. NOTIFICATION

If a Contractor contends that any Union has violated this Article, it will notify the appropriate district or area council of the Local Union involved advising of such fact, with copies of the notification to the Local Union and the BTC. The district or area council, and the BTC shall each instruct, order and otherwise use their best efforts to cause the employees, and/or the Local Unions to immediately cease and desist from any violation of this Article. A district or area council, or the BTC complying with these obligations shall not be liable for the unauthorized acts of a Local Union or its members.

SECTION 4. EXPEDITED ARBITRATION

Any Contractor or Union alleging a violation of Section 1 of this Article may utilize the expedited procedure set forth below (in lieu of, or in addition to, any actions at law or equity) that may be brought.

A. A party invoking this procedure shall notify J.J. Pierson Jr, Esq., at 51 JFK Parkway, First Floor West, Short Hills, New Jersey 07078, telephone number (973) 359-8100, fax number (973) 359-8161**,** or e-mail jjpierson@jjpierson.com, who shall serve as Arbitrator under this expedited arbitration procedure. In the event that J.J. Pierson is unable to serve, a party invoking this procedure shall notify Louis Verrone, who shall serve as arbitrator under this expedited procedure. Copies of such notification will be simultaneously sent to the alleged violator and, if a Local Union is alleged to be in violation, it's International, the GC and/or PMF, and the BTC.

B. The Arbitrator shall thereupon, after notice as to time and place to the Contractor, the GC and/or PMF, the Local Union involved, and the BTC, hold a hearing within 48 hours of receipt of the notice invoking the procedure it is contended that the violation still exists. The hearing will not, however, be scheduled for less than 24 hours after the notice to the district or area council required by Section 3 above. Hearings shall be held at the

jobsite or at the Newark office of the New Jersey State Board of Mediation, as directed by the Arbitrator.

C. All notices pursuant to this Article may be by telephone, telegraph, hand delivery, or fax, confirmed by overnight delivery, to the arbitrator, Contractor or Union involved. The hearing may be held on any day including Saturdays or Sundays. The hearing shall be completed in one session, which shall not exceed 8 hours duration (no more than 4 hours being allowed to either side to present their case, and conduct their cross examination) unless otherwise agreed. A failure of any Union or Contractor to attend the hearing shall not delay the hearing of evidence by those present or the issuance of an award by the Arbitrator.

D. The sole issue at the hearing shall be whether a violation of Section 1, above, occurred. If a violation is found to have occurred, the Arbitrator shall issue a Cease and Desist Award restraining such violation and serve copies on the Contractor and Union involved. The Arbitrator shall have no authority to consider any matter in justification, explanation or mitigation of such violation or to award damages, which issue is reserved solely for court proceedings, if any. The Award shall be issued in writing within 3 hours after the close of the hearing, and may be issued without an Opinion. If any involved party desires an Opinion, one shall be issued within 15 calendar days, but its issuance shall not delay compliance with, or enforcement of, the Award.

E. An Award issued under this procedure may be enforced by any court of competent jurisdiction upon the filing of the Agreement together with the Award. Notice of the filing of such enforcement proceedings shall be given to the Union or Contractor involved. In any court proceeding to obtain a temporary or preliminary order enforcing the arbitrator's Award as issued under this expedited procedure, the involved Union and Contractor waive their right to a hearing and agree that such proceedings may be ex parte,

provided notice is given to opposing counsel. Such agreement does not waive any party's right to participate in a hearing for a final court order of enforcement or in any contempt proceeding.

F. Any rights created by statue or law governing arbitration proceedings which are inconsistent with the procedure set forth in this Article, or which interfere with compliance thereto, are hereby waived by the Contractors and Unions to whom they accrue.

G. The fees and expenses of the Arbitrator shall be equally divided between the involved Contractor and Union.

SECTION 5. ARBITRATION OF DISCHARGES FOR VIOLATION

Procedures contained in Article 9 shall not be applicable to any alleged violation of this Article, with the single exception that an employee discharged for violation of Section 1, above, may have recourse to the procedures of Article 9 to determine only if the employee did, in fact, violate the provisions of Section 1 of this Article; but not for the purpose of modifying the discipline imposed where a violation is found to have occurred.

ARTICLE 8. - LOCAL ADMINISTRATIVE COMMITTEE (LAC)

SECTION 1. MEETINGS

The Local Administrative Committee (LAC) will meet on a regular basis to 1) Implement and oversee the Agreement procedures and initiatives; 2) monitor the effectiveness of the Agreement; and 3) identify opportunities to improve efficiency and work execution.

SECTION 2. COMPOSITION

The LAC will be co-chaired by the President of the Union County Building and Construction Trades Council or his designee, and designated official of the GC and/or PMF. It will be

comprised of representatives of the local unions signatory to the project labor agreement (PLA) and representatives of the GC and/or PMF and other contractors on the project.

ARTICLE 9 - GRIEVANCE & ARBITRATION PROCEDURE

SECTION 1. PROCEDURE FOR RESOLUTION OF GRIEVANCES

Any question, dispute or claim arising out of, or involving the interpretation or application of this Agreement (other than jurisdictional disputes or alleged violations of Article 7, Section 1) shall be considered a grievance and shall be resolved pursuant to the exclusive procedure of the steps described below; provided, in all cases, that the question, dispute or claim arose during the term of this Agreement.

Step 1:

A. When any employee covered by this Agreement feels aggrieved by a claimed violation of this Agreement, the employee shall, through the Local Union business representative or job steward give notice of the claimed violation to the work site representative of the involved Contractor. To be timely, such notice of the grievance must be given within 7 calendar days after the act, occurrence, or event giving rise to the grievance, or after the act, occurrence or event became known or should have become known to the Union. The business representative of the Local Union or the job steward and the work site representative of the involved Contractor shall meet and endeavor to adjust the matter within 7 calendar days after timely notice has been given. If they fail to resolve the matter within the prescribed period, the grieving party, may, within 7 calendar days thereafter, pursue Step 2 of the grievance procedure by serving the involved Contractor and the General Contractor and/or Project Management Firm with written copies of the grievance setting forth a description of the claimed violation, the date on which the grievance occurred, the provisions of the Agreement alleged to have been violated. Grievances and disputes settled at Step

1 are non-precedential except as to the specific Local Union, employee and Contractor directly involved, unless the settlement is accepted in writing, by the General Contractor and/or Project Management Firm, as creating a precedent.

B. Should any signatory to this Agreement have a dispute (excepting jurisdictional disputes or alleged violations of Article 7, Section 1) with any other signatory to this Agreement and, if after conferring, a settlement is not reached within 7 calendar days, the dispute shall be reduced to writing and proceed to Step 2 in the same manner as outlined in subparagraph (a) for the adjustment of employee grievances.

Step 2:

The Business Manager or designee of the involved Local Union, together with representatives of the BTC, the involved Contractor, and the General Contractor and/or Project management Firm shall meet in Step 2 within 5 calendar days of the written grievance to arrive at a satisfactory settlement.

Step 3:

A. If the grievance shall have been submitted but not resolved in Step 2, any of the participating Step 2 entities may, within 14 calendar days after the initial Step 2 meeting, submit the grievance in writing (copies to other participants) to J.J. Pierson Jr., Esq., at 51 JFK Parkway, First Floor West, Short Hills, New Jersey 07078, telephone number (973) 359-8100, fax number (973) 359-8161, who shall act as the Arbitrator under this procedure. In the event that J.J. Pierson is unable to serve, a party invoking this procedure shall notify Louis Verrone, who shall serve as arbitrator under this expedited procedure. The Labor Arbitration Rules of the American Arbitration Association shall govern the conduct of the arbitration hearing, at which all Step 2 participants shall be parties. Hearings shall be held at the jobsite or at the Newark office of the New Jersey State Board of Mediation, as directed by the Arbitrator.

The decision of the Arbitrator shall be final and binding on the involved Contractor, Local Union and employees and the fees and expenses of such arbitration's shall be borne equally by the involved Contractor and Local Union.

B. Failure of the grieving party to adhere to the time limits set forth in this Article shall render the grievance null and void. These time limits may be extended only by written consent of the GC and/or PMF, involved Contractor and involved Local Union at the particular step where the extension is agreed upon. The Arbitrator shall have authority to make decisions only on the issues presented to him and shall not have the authority to change, add to, delete or modify any provision of this Agreement.

SECTION 2. LIMITATION AS TO RETROACTIVITY

No arbitration decision or award may provide retroactivity of any kind exceeding 30 calendar days prior to the date of service of the written grievance on the construction Project Manager and the involved Contractor or Local Union.

SECTION 3. PARTICIPATION BY GENERAL CONTRACTOR AND/OR PROJECT MANAGEMENT FIRM

The General Contractor and/or Project Management Firm shall be notified by the involved Contractor of all actions at Steps 2 and 3 and, at its election, may participate in full in all proceedings at these Steps, including Step 3 arbitration.

ARTICLE 10 - JURISDICTIONAL DISPUTES

SECTION 1. NO DISRUPTIONS

There will be no strikes, sympathy strikes, work stoppages, slowdowns, picketing or other disruptive activity of any kind arising out of any jurisdictional dispute. Pending the resolution

of the dispute, the work shall continue uninterrupted and as assigned by the Contractor. No jurisdictional dispute shall excuse a violation of Article 7.

SECTION 2. ASSIGNMENT

A. There shall be a mandatory pre-job markup / assignment meeting prior to the commencement of any work. Attending such meeting shall be designated representatives of the Union signatories to this Agreement, the GC, and the involved Contractors. Best efforts will be made to schedule the pre-job meeting in a timely manner after Notice to Proceed is issued but not later than 30 days prior to the start of the Project.

B. All Project construction work assignments shall be made by the Contractor according to criteria set forth in Section 3, Subsection D 1-3.

C. When a Contractor has made an assignment of work, he shall continue the assignment without alteration unless otherwise directed by an arbitrator or there is agreement between the National or International Unions involved. Claims of a change of original assignment shall be processed in accordance with Article I of the Procedural Rules of the Plan for the Settlement of Jurisdictional Disputes in the Construction Industry ("the Plan").

D. In the event that a Union involved in the change of original assignment dispute is an affiliate of a National or International Union that is not affiliated with the Building and Construction Trades Department and does not wish to process a case through the Plan, the parties shall mutually select one of the following Arbitrators: Arbitrator J.J. Pierson, Arbitrator Paul Greenberg or Arbitrator Richard K. Hanft and submit the dispute directly to the Arbitrator. The selected Arbitrator shall determine whether the case requires a hearing or may be decided upon written submissions. In rendering his determination on whether there has been a change of original assignment, the Arbitrator shall be governed by the following:

1. The contractor who has the responsibility for the performance and installation shall make a specific assignment of the work which is included in his contract to a particular union(s). For instance, if contractor A subcontracts certain work to contractor B, then contractor B shall have the responsibility for making the specific assignments for the work included in his contract. If contractor B, in turn, shall subcontract certain work to contractor C, then contractor C shall have the responsibility for making the specific assignment for the work included in his contract. After work has been so assigned, such assignment will be maintained even though the assigning contractor is replaced and such work is subcontracted to another contractor. It is a violation of the Agreement for the contractor to hold up disputed work or shut down a project because of a jurisdictional dispute.

2. When a contractor has made an assignment of work, he shall continue the assignment without alteration unless otherwise directed by an arbitrator or there is agreement between the National or International Unions involved.

3. Unloading and/or handling of materials to stockpile or storage by a trade for the convenience of the responsible contractor when his employees are not on the job site, or in an emergency situation, shall not be considered to be an original assignment to that trade.

4. Starting of work by a trade without a specific assignment by an authorized representative of the responsible contractor shall not be considered an original assignment to that trade, provided that the responsible contractor, or his authorized representative, promptly, and, in any event, within eight working hours following the start of work, takes positive steps to stop further unauthorized performance of the work by that trade.

SECTION 3. PROCEDURE FOR SETTLEMENT OF DISPUTES

A. Any Union having a jurisdictional dispute with respect to Project work assigned to

another Union will submit through its International the dispute in writing to the Administrator of the Plan within 72 hours and send a copy of the letter to the other Union involved, the Contractor involved, the General Contractor, the BTC, and the district or area councils of the unions involved. Upon receipt of a dispute letter from any Union, the Administrator will invoke the procedures set forth in the Plan to resolve the jurisdictional dispute. The jurisdictional dispute letter shall contain the information described in Article IV of the Procedural Rules of the Plan.

B. Within 5 calendar days of receipt of the dispute letter, there shall be a meeting of the General Contractor, the Contractor involved, the Local Unions involved and designees of the BTC and the district or area councils of the Local Unions involved for the purpose of resolving the jurisdictional dispute.

C. In order to expedite the resolution of jurisdictional disputes, the parties have agreed in advance to mutually select one of the following designated Arbitrators: Arbitrator J. J. Pierson, Arbitrator Paul Greenberg or Arbitrator Richard K. Hanft to hear all unresolved jurisdictional disputes arising under this Agreement. All other rules and procedures of the Plan shall be followed. If none of the three Arbitrators is available to hear the dispute within the time limits of the Plan, the Plan's arbitrator selection process shall be utilized to select another arbitrator.

D. In the event that a Union involved in the dispute is an affiliate of a National or International Union that is not affiliated with the Building and Construction Trades Department and does not wish to process a case through the Plan as described in paragraphs A-C above, the parties to the dispute shall mutually select one of the following Arbitrators: Arbitrator J. J. Pierson, Arbitrator Paul Greenberg or Arbitrator Richard K. Hanft to hear the dispute and shall submit the dispute directly to the selected arbitrator. The time limits for submission and processing disputes shall be the same as provided elsewhere in this Section. The selected Arbitrator shall schedule the hearing within seven business days from the date of submission. If he cannot hear the case within the required timeframe, one of the other Arbitrators will be selected to hear the case unless all parties to the dispute agree to waive the seven day time limit. In rendering his decision, the Arbitrator shall determine:

1. First whether a previous agreement of record or applicable agreement, including a disclaimer agreement, between the National and International Unions to the dispute governs;
2. Only if the Arbitrator finds that the dispute is not covered by an appropriate or applicable agreement of record or agreement between the crafts to the dispute, he shall then consider the established trade practice in the industry and prevailing practice in the locality. Where there is a previous decision of record governing the case, the Arbitrator shall give equal weight to such decision of record, unless the prevailing practice in the locality in the past ten years favors one craft. In that case, the Arbitrator shall base his decision on the prevailing practice in the locality. Except, that if the Arbitrator finds that a craft has improperly obtained the prevailing practice in the locality through raiding, the undercutting of wages or by the use of vertical agreements, the Arbitrator shall rely on the decision of record and established trade practice in the industry rather than the prevailing practice in the locality.
3. Only if none of the above criteria is found to exist, the Arbitrator shall then consider that because efficiency, cost or continuity and good management are essential to the wellbeing of the industry, the interests of the consumer or the past practices of the employer shall not be ignored.

The Arbitrator shall set forth the basis for his decision and shall explain his findings regarding the applicability of the above criteria. If lower-ranked criteria are relied upon, the Arbitrator shall explain why the higher-ranked criteria were not deemed applicable. The Arbitrator's decision shall only apply to the job in dispute.

Each party to the arbitration shall bear its own expense for the arbitration and agrees that the fees and expenses of the Arbitrator shall be borne by the losing party or parties as determined by the Arbitrator.

E. The Arbitrator shall render a short-form decision within 5 days of the hearing based upon the evidence submitted at the hearing, with a written decision to follow within 30 days of the close of hearing.

F. This Jurisdictional Dispute Resolution Procedure will only apply to work performed

by Local Unions that represent workers employed on the Project.

G. Any Local Union involved in a jurisdictional dispute on this Project shall continue working in accordance with Section 2 above and without disruption of any kind.

SECTION 4. AWARD

Any award rendered pursuant to this Article and the Plan shall be final and binding on the disputing Local Unions and the involved Constructor on this Project only and may be enforced in accordance with the provisions of Article VII of the Plan. Any award rendered pursuant to the alternate procedures of this Article shall be final and binding on the disputing Local Unions and the involved Contractor on this Project only, and may be enforced in any court of competent jurisdiction. Such award or resolution shall not establish a precedent on any other construction work not covered by this Agreement. In all disputes under this Article, the General Contractor and the involved Contractors shall be considered parties in interest.

SECTION 5. LIMITATIONS

The Arbitrator shall have no authority to assign work to a double crew, that is, to more employees than the minimum required by the Contractor to perform the work involved; nor to assign work to employees who are not qualified to perform the work involved; nor to assign work being performed by non-union employees to union employees. This does not prohibit the establishment, with the agreement of the involved Contractor, of composite crews where more than 1 employee is needed for the job. The aforesaid determinations shall decide only to whom the disputed work belongs.

SECTION 6. NO INTERFERENCE WITH WORK

A. There shall be no interference or interruption of any kind with the work of the Project while any jurisdictional dispute is being resolved. The work shall proceed as assigned by the Contractor until finally resolved under the applicable procedure of this Article.

The award shall be confirmed in writing to the involved parties. There shall be no strike, work stoppage or interruption in protest of any such award. Any claims of a violation of this section shall be submitted and processed in accordance with the impediment to job progress provisions of the Plan.

B. In the event a Union alleged to have engaged in an impediment to job progress is an affiliate of a National or International Union that is not affiliated with the Building and Construction Trades Department and does not wish to have the impediment to job progress charge processed through the Plan, the parties to the dispute shall mutually select one of the three Arbitrators designated in this Article to hear the dispute. The selected Arbitrator shall schedule the hearing within two business days from the date of submission. If he cannot hear the case within the required timeframe, one of the other Arbitrators shall be selected by the parties to hear the case unless all parties to the dispute agree to waive the two day time limit. The sole issue at the hearing shall be whether or not a violation of this Section has in fact occurred, and the Arbitrator shall have no authority to consider any matter in justification, explanation or mitigation of such violation or to award damages. The Arbitrator's decision shall be issued in writing within 3 hours after the close of the hearing, and may be issued without an opinion. If any party desires an opinion, one shall be issued within 15 days, but its issuance shall not delay compliance with, or enforcement of, the decision. The Arbitrator may order cessation of the violation of this Section and other appropriate relief, and such decision shall be served on all parties by facsimile upon issuance. Each party to the arbitration shall bear its own expense for the arbitration and agrees that the fees and expenses of the Arbitrator shall be borne by the losing party or parties as determined by the Arbitrator.

ARTICLE 11 - WAGES AND BENEFITS

SECTION 1. CLASSIFICATION AND BASE HOURLY RATE

All employees covered by this Agreement shall be classified in accordance with the work performed and paid the base hourly wage rates for those classifications as specified in the attached Schedules A, as amended during this Agreement. Recognizing, however, that special

conditions may exist or occur on the Project, the parties, by mutual agreement may establish rates and/or hours for one or more classifications, which may differ from Schedules A. Parties to such agreements shall be the General Contractor and/or Project Management Firm, the Contractor involved, the involved Local Unions and the BTC.

SECTION 2. EMPLOYEE BENEFIT FUNDS

A. The Contractors agree to pay contributions on behalf of all employees covered by this Agreement to the established employee benefit funds in the amounts designated in the appropriate Schedule A. Bona fide jointly trusted fringe benefit plans established or negotiated through collective bargaining during the life of this Agreement may be added. However, if a defined benefit pension fund covered by the terms and conditions of this Agreement has not adopted the building and construction industry exemption authorized by subsection (b) of Section 4203 of the Employee Retirement Income Security Act of 1974, the Contractor shall not be obligated to hire employees covered by that fund.
B. The Contractor agrees to be bound by the written terms of the legally established Trust Agreements specifying the detailed basis on which payments are to be paid into, and benefits paid out of, such Trust Funds but only with regard to work done on this Project and only for those employees to whom this Agreement requires such benefit Payments.
C. Should any contractor or sub-contractor become delinquent in the payment of contributions to the fringe benefit funds, then the subcontractor at the next higher tier, or upon notice of the delinquency claim from the Union or the Funds, agrees to withhold from the subcontractor such disputed amount from the next advance, or installment payment for work performed and the amount claimed and owed will be paid within thirty (30) days after receipt of the notification by the General Contractor and/or Project Management Firm, if not paid prior to said date by the delinquent contractor/subcontractor.

ARTICLE 12 - HOURS OF WORK, PREMIUM PAYMENTS, SHIFTS AND HOLIDAYS

SECTION 1. WORK WEEK AND WORK DAY

A. The standard work week shall consist of 40 hours of work at straight time rates per one of the following schedules:

1) Five-Day Work Week: Monday-Friday, 5 days, 8 hours plus 1/2 hour unpaid lunch period each day.

B. The Day Shift shall commence between the hours of 6:00 a.m. and 9:00 a.m. and shall end between the hours of 2:30 p.m. and 5:30 p.m. Starting and quitting times shall occur at the employees' place of work as may be designated by the Contractor in accordance with area practice.

C. Notice - Contractors shall provide not less than 5 days prior notice to the Local Union involved as to the work week and work hours schedules to be worked or such lesser notice as may be mutually agreed upon.

SECTION 2. OVERTIME

Overtime pay for hours outside of the standard work week and work day, described in paragraph A above, shall be paid in accordance with the applicable Schedule A. There will be no restriction upon the Contractor's scheduling of overtime or the non-discriminatory designation of employees who shall be worked, except as noted in Article 5, Section 2. There shall be no pyramiding of overtime pay under any circumstances. The Contractor shall have the right to schedule work so as to minimize overtime.

SECTION 3. SHIFTS

A. Flexible Schedules - Scheduling of shift work shall remain flexible in order to meet Project schedules and existing Project conditions including the minimization of interference with traffic. It is not necessary to work a day shift in order to schedule a second shift. Shifts must be worked a minimum of five consecutive work days, must have prior

approval of the Construction Project Manager and must be scheduled with not less than five work days' notice to the Local Union.

B. Second/Shift - The second shift (starting between 2 p.m. and 8p.m.) shall consist of 8 hours work (or 10 hours of work) for an equal number of hours pay at the straight time rate plus 15% in lieu of overtime and exclusive of a 1/2 hour unpaid lunch period.

C. Flexible Starting Times – Shift starting times will be adjusted by the Contractor as necessary to fulfill Project requirements subject to the notice requirements of Paragraph A.

D. It is agreed that when project circumstances require a deviation form the above shifts, the involved unions, contractors and the General Contractor and/or Project Management Firm shall adjust the starting times of the above shifts or establish shifts which meet the project requirements. It is agreed that neither party will unreasonably withhold their agreement.

SECTION 4. HOLIDAYS

A. Schedule - There shall be 8 recognized holidays on the Project:

New Year's Day	Labor Day
Presidents Day	Veterans Day
Memorial Day	Thanksgiving Day
Fourth of July	Christmas Day

* Presidential Election Day shall be observed as a holiday in a general election year. Work shall be scheduled on Good Friday pursuant to the craft's Schedule A. The Friday after Thanksgiving shall be observed as a holiday for Elevator Constructors Local 1 only.

All said holidays shall be observed on the dates designated by New Jersey State Law. In the absence of such designations, they shall be observed on the calendar date except those holidays which occur on Sunday shall be observed on the following Monday. Holidays falling on Saturday are to be observed on the preceding Friday.

B. Payment - Regular holiday pay, if any, and/or premium pay for work performed on such a recognized holiday shall be in accordance with the applicable Schedule A.

C. Exclusivity - No holidays other than those listed in Section 4-A above shall be recognized nor observed.

SECTION 5. REPORTING PAY

A. Employees who report to the work location pursuant to regular schedule and who are not provided with work or whose work is terminated early by a Contractor, for whatever reason, shall receive minimum reporting pay in accordance with the applicable Schedule A.

B. When an employee, who has completed their scheduled shift and left The Project site, is "called back" to perform special work of a casual, incidental or irregular nature, the employee shall receive pay for actual hours worked with a minimum guarantee, as may be required by the applicable Schedule A.

C. When an employee leaves the job or work location of their own volition or is discharged for cause or is not working as a result of the Contractor's invocation of Section 7 below, they shall be paid only for the actual time worked.

D. Except as specifically set forth in this Article there shall be no premiums, bonuses, hazardous duty, high time or other special payments of any kind.

E. There shall be no pay for time not actually worked except as specifically set forth in this Agreement or except where specifically provided in an applicable Schedule A.

SECTION 6. PAYMENT OF WAGES

A. Payday - Payment shall be made by check, drawn on a New Jersey bank with branches located within commuting distance of the job site. Paychecks shall be issued by the Contractor at the job site by 10 a.m. on Thursdays. In the event that the following Friday is a bank holiday, paychecks shall be issued on Wednesday of that week. Not more than 3 days wages shall be held back in any pay period. Paycheck stubs shall contain the name and business address of the Contractor, together with an itemization of deductions from gross wages.

B. Termination-Employees who are laid-off or discharged for cause shall be paid in full for that which is due them at the time of termination. The Contractors shall also provide the employee with a written statement setting forth the date of lay off or discharge.

SECTION 7. EMERGENCY WORK SUSPENSION

A Contractor or GC and/or PMF may, if considered necessary for the protection of life and /or safety of employees or others, suspend all or a portion of Project Work. In such instances, employees will be paid for actual time worked; provided, however, that when a Contractor request that employees remain at the job site available for work, employees will be paid for "stand-by" time at their hourly rate of pay.

SECTION 8. INJURY/DISABILITY

An employee who, after commencing work, suffers a work-related injury or disability while performing work duties, shall receive no less than 8 hours wages for that day. Further, the employee shall be rehired at such time as able to return to duties provided there is still work available on the Project for which the employee is qualified and able to perform.

SECTION 9. TIME KEEPING

A Contractor may utilize brassing or other systems to check employees in and out. Each employee must check in and out. The Contractor will provide adequate facilities for checking in and out in an expeditious manner.

SECTION 10. MEAL PERIOD

A Contractor shall schedule an unpaid period of not more than 1/2 hour duration at the work location between the 3rd and 5th hour of the scheduled shift. A Contractor may, for efficiency of operation, establish a schedule which coordinates the meal periods of two or more crafts. If an employee is required to work through the meal period, the employee shall be compensated in a manner established in the applicable Schedule A.

SECTION 11. BREAK PERIODS

There will be no rest periods, organized coffee breaks or other non-working time established during working hours. Individual coffee containers will be permitted at the employee's work location. Local area practice will prevail for coffee breaks that are not organized.

ARTICLE 13 - APPRENTICES

SECTION 1. RATIOS

Recognizing the need to maintain continuing supportive programs designed to develop adequate numbers of competent workers in the construction industry and to provide craft entry opportunities for minorities, women and economically disadvantaged non-minority males, Contractors will employ apprentices in their respective crafts to perform such work as is within their capabilities and which is customarily performed by the craft in which they are indentured. Contractors may utilize apprentices and such other appropriate classifications as are contained in the applicable Schedule A in a ratio not to exceed the ratio provided in the applicable Schedule A collective bargaining agreements providing prevailing wage and fringe benefits as defined in N.J.S.A. 34:11-56.26(9) for the classification in Union County, New Jersey. Apprentices and such other classifications as are appropriate shall be employed in a manner consistent with the provisions of the appropriate collective bargaining agreement listed in Schedule A.

SECTION 2. DEPARTMENT OF LABOR

To assist the Contractors in attaining a maximum effort on this Project, the Unions agree to work in close cooperation with, and accept monitoring by, the New Jersey State and Federal Departments of Labor to ensure that minorities, women, or economically disadvantaged are afforded opportunities to participate in apprenticeship programs which result in the placement of apprentices on this Project. To further ensure that this Contractor effort is attained, up to 50% of the apprentices placed on this Project should be first year, minority, women or economically disadvantaged apprentices. The Local Unions will cooperate with Contractor request for minority, women or economically disadvantaged referrals to meet this Contractor effort.

SECTION 3. HELMETS TO HARDHATS

The Employers and the Unions recognize a desire to facilitate the entry into the building and construction trades of veterans who are interested in careers in the building and construction industry. The Employers and Unions agree to utilize the services of the Center for Military recruitment, Assessment and Veterans Employment (hereinafter "Center") and the Center's "Helmets to Hardhats" program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the parties.

The Unions and Employers agree to coordinate with the Center to create and maintain an integrated database of veterans interested in working on the Project and of apprenticeship and employment opportunities for the Project. To the extent permitted by law, the Unions will give credit to such veterans for bona fide, provable past experience.

ARTICLE 14 - SAFETY PROTECTION OF PERSON AND PROPERTY

SECTION 1. SAFETY REQUIREMENTS

Each Contractor will ensure that applicable OSHA requirements and other requirements set forth in the contract documents are at all times maintained on the Project and the employees and Unions agree to cooperate fully with these efforts. Employees must perform their work at all times in a safe manner and protect themselves and the property of the Contractor and the Owner from injury or harm. Failure to do so will be grounds for discipline, including discharge.

SECTION 2. CONTRACTOR RULES

Employees covered by this Agreement shall at all times be bound by the reasonable safety, security, and visitor rules as established by the Contractors and the GC and/or PMF for this Project. Such rules will be published and posted in conspicuous places throughout the Project.

SECTION 3. INSPECTIONS

The Contractors and GC and/or PMF retain the right to inspect incoming shipments of equipment, apparatus, machinery and construction materials of every kind.

ARTICLE 15 - NO DISCRIMINATION

SECTION 1. COOPERATIVE EFFORTS

The Contractors and Unions agree that they will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin or age in any manner prohibited by law or regulation. It is recognized that special procedures maybe established by Contractors and Local Unions and the New Jersey State Department of Labor for the training and employment of persons who have not previously qualified to be employed on construction projects of the type covered by this Agreement. The parties to this Agreement will assist in such programs and agree to use their best efforts to ensure that the goals for female and minority employment are met on this Project.

SECTION 2. LANGUAGE OF AGREEMENT

The use of the masculine or feminine gender in this Agreement shall be construed as including both genders.

ARTICLE 16 - GENERAL TERMS

SECTION 1. PROJECT RULES

The Project Management Firm and the Contractors shall establish such reasonable Project rules as are appropriate for the good order of the Project, provided they do not violate the terms of this agreement. These rules will be explained at the pre-job conference and posted at the Project site and may be amended thereafter as necessary. Failure of an employee to observe these rules and regulations shall be grounds for discipline, including discharge. The fact that no order was

posted prohibiting a certain type of misconduct shall not be a defense to an employee disciplined or discharged for such misconduct when the action taken is for cause.

SECTION 2. TOOLS OF THE TRADES

The welding/cutting torch and chain fall are tools of the trade having jurisdiction over the work performed. Employees using these tools shall perform any of the work of the trade. There shall be no restrictions on the emergency use of any tools or equipment by any qualified employee, or on the use of any tools or equipment for the performance of work within the employee's jurisdiction.

SECTION 3. SUPERVISION

Employees shall work under the supervision of the craft foreperson or general foreperson.

SECTION 4. TRAVEL ALLOWANCES

There shall be no payments for travel expenses, travel time, subsistence allowance or other such reimbursements or special pay except as expressly set forth in this Agreement and in Schedule A.

SECTION 5. FULL WORK DAY

Employees shall be at their staging area at the starting time established by the Contractor and shall be returned to their staging area by quitting time after performing their assigned functions under the supervision of the Contractor. The signatories reaffirm their policy of a fair day's work for a fair day's wage.

SECTION 6. COOPERATION

The Project Management Firm and/or General Contractor and the Unions will cooperate in seeking any NJS Department of Labor approvals that may be required for implementation of any terms of this Agreement.

ARTICLE 17 - SAVINGS AND SEPARABILITY

SECTION 1. THIS AGREEMENT

In the event that the application of any provision of this Agreement is enjoined, on either an interlocutory or permanent basis, or otherwise found in violation of law, the provision involved shall be rendered, temporarily or permanently, null and void but the remainder of the Agreement shall remain in full force and effect. In such event, the Agreement shall remain in effect for contracts already bid and awarded or in construction where the Contractor voluntarily accepts the Agreement. The parties to this Agreement will enter into negotiations for a substitute provision in conformity with the law and the intent of the parties for contracts to be let in the future.

SECTION 2. THE BID SPECIFICATIONS

In the event that the General Contractor's and/or Project Management Firm's bid specifications, or other action, requiring that a successful bidder become signatory to this Agreement is enjoined, on either an interlocutory or permanent basis, or otherwise found in violation of law such requirement shall be rendered, temporarily or permanently, null and void but the Agreement shall remain in full force and effect to the extent allowed by law. In such event, the Agreement shall remain in effect for contracts already bid and awarded or in constructions where the Contractor voluntarily accepts the Agreement. The parties will enter into negotiations as to modifications to the Agreement to reflect the court action taken and the intent of the parties for contracts to be let in the future.

SECTION 3. NON-LIABILITY

In the event of an occurrence referenced in Section 1 or Section 2 of this Article, neither the Owner, the Project Management Firm and/or General Contractor, or any Contractor, or any signatory Union shall be liable, directly or indirectly, for any action taken, or not taken, to comply with any court order, injunction or determination. Project bid specifications will be

issued in conformance with court orders in effect and no retroactive payments or other action will be required if the original court determination is ultimately reversed.

SECTION 4. NON-WAIVER

Nothing in this Article shall be construed as waiving the prohibitions of Article 7 as to signatory Contractors and signatory Unions.

ARTICLE 18 - FUTURE CHANGES IN SCHEDULE A AREA CONTRACTS

SECTION 1. CHANGES TO AREA CONTRACTS

A. Schedules A to this Agreement shall continue to full force and effect until the Contractor and/or Union parties to the Area Collective Bargaining Agreements which are the basis for Schedules A notify the General Contractor and/or Project Management Firm in writing of the mutually agreed upon changes in provisions of such agreements which are applicable to the Project, and their effective dates.

B. It is agreed that any provisions negotiated into Schedules A collective bargaining agreements will not apply to work on this Project if such provisions are less favorable to this Project than those uniformly required of contractors for construction work normally covered by those agreements; nor shall any provisions be recognized or applied on this Project if it may be construed to apply exclusively, or predominantly, to work covered by this Project Agreement.

C. Any disagreement between signatories to this Agreement over the incorporation into Schedules "A" of provisions agreed upon in the renegotiations of Area Collective Bargaining Agreements shall be resolved in accordance with the procedure set forth in Article 9 of this Agreement.

SECTION 2. LABOR DISPUTES DURING AREA CONTRACT NEGOTIATIONS

The Unions agree that there will be no strikes, work stoppages, sympathy actions, picketing, slowdowns or other disruptive activity or other violations of Article 7 affecting the Project by any Local Union involved in the renegotiations of Area Local Collective Bargaining Agreements

nor shall there by any lock-out on the Project affective a Local Union during the course of such renegotiations.

IN WITNESS WHEREOF the parties have caused this Agreement to be executed and effective as of the first day of _____ ___, 2023.

Union County Improvement Authority	**Union County Building and Construction Trades Council AFL-CIO**
_____	_____

UNION AFFILIATES	**SIGNATURES**
ASBESTOS WORKER LOCAL 32	_____
BOILER MAKERS LOCAL 28	_____
BRICKLAYERS AND ALLIED CRAFTS LOCAL 4	_____
CARPENTERS LOCAL 254	_____
DOCKBUILDERS LOCAL 1556	_____
ELECTRICAL WORKERS LOCAL 102	_____
ELECTRICAL WORKERS LOCAL 164 (TELECOM)	_____
ELEVATOR CONSTRUCTORS LOCAL 1	_____
OPERATING ENGINEERS LOCAL 825	_____
IRONWORKERS LOCAL 11	_____
STEAMFITTERS LOCAL 475	_____
LABORERS LOCAL 3	_____
HEAVY CONSTRUCTION LABORERS LOCAL 472	_____

PAINTERS AND ALLIED TRADES, DISTRICT COUNCIL 21 _____

PLUMBERS LOCAL 24 _____

RESILIENT FLOORING LOCAL 251 _____

ROOFERS LOCAL 4 _____

SHEET METAL WORKERS LOCAL 22 _____

SHEET METAL WORKERS LOCAL 25 _____

SPRINKLER FITTERS LOCAL 696 _____

TILE/MARBLE/TERRAZO WORKERS LOCAL 7 _____

TEAMSTERS LOCAL 560 _____

OPERATIVE PLASTERER LOCAL 29 _____

MILLWRIGHTS LOCAL 715 _____

PROJECT LABOR AGREEMENT
COVERING CONSTRUCTION OF THE RENOVATION & ADDITION OF THE
UNION COLLEGE OF UNION COUNTY
PHYSICAL EDUCATION CENTER PROJECT
IN CRANFORD, NEW JERSEY

TELE-DATA ADDENDUM

The parties hereby agree that all Tele-data work and associated electrical work performed on any of the sites during construction shall be done by employees represented by the signatory unions. For the purpose of this Agreement, Tele-data work shall include, but not limited to, the following: All receiving, placement, installation, operation, testing, inspection, maintenance, repair and service of radio, television, video, data, voice, sound, emergency call, microwave and visual production and reproduction apparatus, equipment and appliances used for domestic, commercial, education and entertainment purposes; all installation and erection of equipment, apparatus or appliance, cables and/or wire, emergency power (batteries) and all directly related work which becomes an integral part of the telecommunication and/or telecommunications related systems repair and service maintenance work of telecommunications systems and devices including, but not limited to, Private Branch Exchanges (PBX-PABX), Key equipment-owned, CCTV, CATV, card access, Systems RS 232 ethernet and/or any local area network system associated with computer installation.

_____	**SIGNATORY UNIONS**
BY:_____	BY:_____

PROJECT LABOR AGREEMENT
COVERING CONSTRUCTION OF THE RENOVATION & ADDITION OF THE
UNION COLLEGE OF UNION COUNTY
PHYSICAL EDUCATION CENTER PROJECT
IN CRANFORD, NEW JERSEY

SHEET METAL ADDENDUM

(General Contractor) (Project Management Firm) agrees that when subcontracting for prefabrication of H.V.A.C. duct and other related sheet metal, such prefabrication shall be subcontracted to fabricators who pay their employees engaged in such fabrication not less than the prevailing wage for comparable sheet metal fabrication as established under agreements between local affiliates of Sheet Metal Workers' International Association and local sheet metal fabricators.

(General Contractor) (Project Management Firm) and the Sheet Metal Workers' International Association agree to work with fabrication shops referenced in the Addendum. This joint effort will be directed at improving fabricators' competitiveness through the application of continuous improvement principles.

_____
(General Contractor)
(Project Management Firm)

Sheet Metal Workers'
International Assoc. Local #25

Sheet Metal Workers'
International Assoc. Local #22

TEAMSTERS LOCAL 560 ADDENDUM

1. Notwithstanding the provisions of Article 11, Section 2 of the Project Labor Agreement, a Contractor who becomes signatory to this Project Labor Agreement who is not already a participating and contributing employer to the pension fund(s) specified in the Exhibit A collective bargaining agreement (currently the Trucking Employees of North Jersey Pension Fund;, hereinafter the "TENJ Pension Fund," and the Teamsters Local No. 408 Pension Fund), shall make direct all contributions required by the Exhibit A collective bargaining agreement exclusively to the Trucking Employees of North Jersey Annuity Fund, a defined contribution plan. Any such Contractor shall not participate in nor contribute to the TENJ or Local 408 Pension Funds, and shall have no obligation to the TENJ or Local 408 Pension Funds.

2. Any Contractor who is already participating in and contributing to the TENJ or Local 408 Pension Fund, separately from this Project Labor Agreement, shall pay contributions as provided for in Article 11, Section 2 of this Project Labor Agreement.

Agreed to and accepted this _____ day of _____, 2023:

For the General Contractor: For Teamsters Local 560

_____ _____

PROJECT LABOR AGREEMENT
LETTER OF ASSENT

Re: Project Labor Agreement
The Union County Building & Trades Council, AFL-CIO and
_____
dated _____
(the "Agreement')

The undersigned, as a General Contractor and/or Project Management Firm, Contractor(s) or Subcontractor(s) on a Contract which is part of the Construction of the Renovation & Addition of the Union College of Union County Physical Education Center Project in Cranford, New Jersey (the "Project"), for and in consideration of the award of a Contract to perform work on said Project, and in further consideration of the mutual promises made in the Project Labor Agreement, a copy of which was received and is acknowledged, hereby:

(1) On behalf of itself and all its employees, accepts and agrees to be bound by the terms and conditions of the Project Labor Agreement, together with any and all amendments and supplements now existing or which are later made thereto, and understands that any act of non-compliance with all such terms and conditions will subject the non-complying Contractor or employee(s) to being prohibited from the Project Site until full compliance is obtained.

(4) Certifies that it has no commitments or agreements that would preclude its full compliance with the terms and conditions of said Projects Labor Agreement.

(5) Agrees to secure from any Contractor(s) (as defined in said Project Labor Agreement) which is or becomes a Subcontractor(s) (of any tier), a duly executed Letter of Assent in form identical to this document prior to commencement of any work.

_____
Company Name

By: _____ Contract Number_____

Title: _____ General Contractor_____

Date: _____

cc: (Unions employed by Contractor)

APPENDIX D

GEOTECHNICAL INVESTIGATION REPORT

Gymnasium Addition
UCNJ Union College of Union County – Cranford Campus

1033 Springfield Avenue
Cranford, NJ 07016

Geotechnical Investigation Report
April 2, 2025

Prepared for:
DI Group Architecture
2450 West Hunting Park Avenue
Philadelphia, PA 19129

Submitted by:
K. Charles Westen, PE
NJ License No. 47013

K. Charles Westen
Signature

April 3, 2025
Date

STATE OF NEW JERSEY
K. CHARLES WESTEN
No. GE47013
LICENSED PROFESSIONAL ENGINEER

Prepared by:
Remington & Vernick Engineers
2059 Springdale Road
Cherry Hill, New Jersey 08003
Office Phone: (856) 795-9595
RVE Project Number: 4030X002

RVE 1901 REMINGTON & VERNICK ENGINEERS

GEOTECNICAL INVESTIGATION REPORT

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Appendix F – Seismic Information

INTRODUCTION

Remington & Vernick Engineers (RVE) has prepared this report which presents the findings, conclusions, and recommendations of a geotechnical investigation conducted for a new Gymnasium Addition on the Cranford Campus of Union College of Union County (UCNJ). The proposed addition is expected to be primarily a single-story structure located adjacent to the existing campus buildings at 1033 Springfield Avenue, Cranford, Union County, New Jersey.

The purpose of the geotechnical investigation is to determine the subsurface conditions at the site and to provide recommendations, from a geotechnical engineering viewpoint, for the most suitable type of foundation, site preparation, earthwork operations, and other geotechnical considerations.

SITE & PROJECT DESCRIPTION

The proposed new gymnasium facility will be an addition to the existing UCNJ Cranford Campus buildings and will be located on the southwestern portion of the campus complex. The new gymnasium addition will be permanently a single-story structure with a 2-story portion located in the northeastern corner of the addition. The addition will be attached to the southern and western sides of the existing student commons and campus center building. Presently, the site of the proposed addition is relatively flat, and is currently being utilized as part of a student parking lot and a grassed and landscaped courtyard. The general location of the project site is shown on the Site Location Map in Appendix A of this report.

Based on preliminary information, the proposed building addition is expected to be a steel frame and masonry bearing wall structure, with a slab on grade and having a footprint of approximately 38,059 square feet. The anticipated building loads were not available to us at the time of report preparation. Final grades were not known however, the final site grades are not expected to change significantly from those that currently exist with only minor cuts and fills required for construction.

SUBSURFACE INVESTIGATION

A Standard Penetration Test (SPT) boring investigation for this project was performed on February 26, 27 and 28, 2025. The investigation consisted of ten (10) SPT test borings drilled by Boring Brothers Inc., utilizing the washed boring method of drilling at locations selected and located in the field by RVE. The soil borings, designated as B-1 through B-10 were drilled to a termination depth of 27 feet below existing grade. All drilling and

soil sampling operations were supervised by RVE, and the field logging of the soil samples was performed by a representative of RVE.

Soil samples were recovered via a two-inch O.D. split-spoon sampler; driven by a hydraulically activated 140-pound hammer, free falling 30 inches (ASTM D 1586). The number of hammer blows required to advance the 24-inch spoon in 6-inch increments (four increments in all) were recorded. The number of blows required to penetrate the middle two increments (6 to 18 inches) is known as the Standard Penetration Resistance (N). Soil samples were obtained continuously in the upper 12 ft and at 5 ft intervals thereafter. Recovered soil samples were visually classified in the field using the *Burmister Soil Identification* System and the *Unified Soil Classification System.* The results of the visual analyses were utilized to prepare the attached Soil Boring Logs located in Appendix C of this report.

The approximate location of the test borings along with other pertinent site information, is shown on the Boring Location Plan, in Appendix B. The soil test boring logs are presented in Appendix C, along with a Glossary of Terms and Definitions.

LABORATORY TESTING

All recovered soil samples were retained by RVE for examination and testing. The field classifications were confirmed or modified as necessary by our geotechnical engineer. Gradation analyses and moisture content determinations were performed by TRC's testing laboratory on samples selected by RVE to determine soil properties and to assist in soil identification. Summaries of the test results, along with graphic presentations of the gradation curves are presented in Appendix E.

SUBSURFACE CONDITIONS

Published Geologic Data

Published geology indicates that the site soils are stratified glacial drift. The glacial soils consist of silts, silty sands, silty gravels, sandy gravels, and gravelly sands occurring in rough layers or beds of varying thickness. The more silty materials are usually found at the surface while the coarser materials lie below. The depth to bedrock is greater than 10 feet.

The geologic information was obtained from the "Engineering Soil Survey of New Jersey," Rutgers University, Report No. 5, Union County, Engineering Research Bulletin Number 19, 1952.

Soils Encountered

The site soils are in general agreement with the published geologic data. Fill was encountered in all borings either beneath a 3-inch layer of topsoil or beneath a 6-inch layer of asphalt pavement. Underlaying the fill soils, granular and cohesive glacial deposits were encountered, and extended to the termination depths of the borings. A detailed description of the soils encountered is shown on the boring logs in Appendix C. A brief general description is given in the following sections.

Fill Stratum: Underlaying a 3-inch layer of topsoil or a 6-inch layer of asphalt pavement, granular and cohesive fill soils were encountered to depths ranging from 2 to 8 feet below existing grade. The granular soils in this stratum can be described as brown, grey and reddish brown coarse to fine sand or silt, with varying amounts of fine crushed stone and clay. The cohesive soils in this stratum can be described as reddish brown clayey silt with some to trace medium to fine sand with little to trace medium to fine crushed stone. The relative density of the granular soils of this stratum varies from loose to very dense with normalized Standard Penetration Test (SPT) resistance N_{60} and $N1_{60}$ values ranging from 5 to over 50 blows per foot (bpf). The relative consistency of the cohesive soils of this stratum varies from firm to very stiff with normalized SPT resistance N_{60}-values ranging from 7 to 27 bpf.

It should be pointed out that it is sometimes difficult, in the absence of foreign materials within the soil matrix, to differentiate between natural soils and fill or regraded soils, even when classified by experienced engineers. Accordingly, the depth of fill could vary from that indicated on the boring logs.

Glacial Stratum: Underlying the fill soils, stratified glacial deposits consisting predominately of granular soils with occasional layers of cohesive soils, were encountered to the termination depth of all borings. The granular soils in this stratum can be described as reddish brown and gray silt or coarse to fine sand with little to no clay, some to no medium to fine gravel and little to no fine rock fragments. Cohesive soils were encountered in boring B-8 through B-10 and consisted of reddish brown clayey with trace to some coarse to fine sand and little medium to fine gravel. The relative density of the granular soils in this stratum varies medium to very dense with normalized SPT resistance N_{60} and $N1_{60}$ values ranging from 12 to over 50 bpf. The relative consistency of the cohesive soils in this stratum varies from stiff to hard with normalized SPT resistance $N1_{60}$-values ranging from 9 to over 50 bpf.

Groundwater

Groundwater was only encountered in borings B-1 through B-3 at depths ranging from 8 to 11 feet below existing grade during the drilling operations and before the introduction of water for the washed boring and casing advancement. It should be noted that this groundwater information represents the conditions encountered at the time of the drilling operations. Groundwater levels generally can fluctuate due to changes in precipitation, infiltration, surface run-off and other hydrogeological factors. Therefore, the groundwater level present at the time of construction may vary from that detected at the time of the drilling operations.

It should also be noted that shallow or perched groundwater might be encountered during excavations for foundation construction, especially if the work commences after a wet weather period. Dewatering of perched water or surface runoff water encountered during construction can be performed using sump pumps.

DISCUSSION & RECOMMENDATIONS

Based on the results of our field investigation and laboratory observations, we have carried out evaluations of the existing subsurface soil conditions to determine their engineering properties for the support of the proposed gymnasium addition, from a geotechnical engineering point of view. The subsurface investigation indicated that the site is underlain by granular and cohesive fills and natural soils of glacial origin that in their present condition are capable of supporting the anticipated loads for the proposed structure.

Site Preparation Procedures & Earthwork Operations

The proposed construction area is defined as the area within the proposed addition limits, and a 5-ft and 3-ft wide zone outside the building and pavements, respectively.

1. Clear and strip from the construction area, any existing asphalt or concrete pavement, landscaping or any other deleterious material. Any existing utilities found within the proposed building limits will have to be rerouted outside the building footprint. Any debris, old foundations or abandoned pipes encountered during excavation, will have to be removed completely from the area under the proposed building to a minimum depth of 2 ft below the bottom slab elevation and completely from the area of the foundations. If any pipes are to be left in place, they must be completely filled with cement grout.

2. Excavate the site, where necessary, to proposed subgrade elevations. Over-excavate any unsuitable material or soils encountered below this elevation in the zone of influence of the foundations. The zone of influence is the volume of soil within lines drawn downward and outward, from the lower edges of a foundation, at a slope of 1.5H:1V. Unsuitable material includes all deleterious material, bricks, debris, rubble, or any other undesirable material designated by the on-site representative of the Geotechnical Engineer. Undesirable natural soils include all soft and loose soils encountered under the bottom of the foundation elevation. Replace the over-excavated material with controlled structural fill as defined herein.

3. After excavation to proposed subgrade and prior to the placement of any fill, the resulting subgrade should be rigorously proof rolled and compacted with a 10-ton heavy-duty static roller. This should be done during a dry and favorable weather period, and under the technical supervision of a representative of the Geotechnical Engineer. A minimum of 8 overlapping passes is recommended to densify the upper 2 to 4 ft of on-site soils. No heavy equipment should be operated within 5 ft of existing structures. Compaction in the vicinity of existing structures should be accomplished using a mechanical compactor such as a walk behind roller or similar device as approved by the Geotechnical Engineer.

4. Undercut any zones of instability disclosed by the proof rolling, as determined by the on-site representative of the Geotechnical Engineer and replace the undercut material with controlled structural fill as defined herein. As required, raise the ground surface to proposed subgrade elevation with controlled structural fill. All material used as controlled structural fill material in the building area should comply with the requirements given herein and approved by the on-site representative of the Geotechnical Engineer.

5. All load-bearing fill should be controlled structural fill placed in loose horizontal lifts with a maximum thickness of 8 inches. Controlled structural fill should consist of inorganic, readily compactable, predominantly well-graded granular soils with no more than 12% fines (material passing the No. 200 sieve), and a maximum particle size of 3 inches. The moisture content of the fill materials should be controlled to within 2% of the optimum moisture content, as determined by ASTM D 1557, by wetting, aeration or blending, as necessary. It is recommended that controlled fill within the construction area be compacted to at least 95% of the maximum dry density, as determined by the Modified Proctor Test (ASTM D 1557). In addition, it is recommended that all fills be stable without significant movement under construction traffic, as judged by the on-site representative of the Geotechnical Engineer. Quality control testing

of in-place fill densities should be conducted throughout the entire earthwork operation.

6. Permanent slopes should not be steeper than 2H:1V and provision should be made to protect the surface against erosion by covering the surface with riprap or a suitable vegetative cover.

Excavation

On the basis of the information provided to us concerning the project, we expect relatively shallow excavations for foundation construction. Deeper excavations may be required for the placement of underground utilities.

Open excavations are feasible provided there is enough room so that the stability of existing structures is not affected. Existing structures may be considered not affected by the open cut excavation if a line projected downward from the bottom edge of the existing footings at a slope of 1.5H:1V does not intersect the excavation slope. Any section of the existing foundations affected by the excavation should be underpinned. We recommend that the depth of the foundations of the existing building should be established before starting the excavation for the proposed addition. Temporary side slopes of open cut excavations should not be steeper than 2H:1V.

If any existing structures will be affected by an open cut excavation, we recommend that the affected structures be underpinned. Alternatively, temporary sheeting and shoring may be used to support the sides of the excavation. If temporary shoring is utilized, the soil parameters presented in the table below may be used for the design of the shoring. All excavations should be in compliance with "Excavating and Trenching Operations" manual (latest revision), issued by the US Department of Labor, OSHA 2226 and local requirements.

Temporary Shoring Design Parameters

Unit Weight of Soil (pcf)	120
Angle of Internal Friction (ϕ)	30°
Coefficient of Active Earth Pressure (K_a)	0.33
Coefficient of Earth Pressure At-rest (K_o)	0.50
Coefficient of Passive Earth Pressure (K_p)	3.0*

* A suitable factor of safety should be applied to K_p.

The lateral load information presented in this report should be used only as a guideline by the contractor, and it should be a requirement for the excavation contractor to prepare a proposed sheeting design certified by a licensed professional engineer prior to construction. The excavation contractor should be responsible for the design, installation, and maintenance of all sheeting and shoring.

Regardless of the excavation option chosen, excavated soils should not be stockpiled adjacent to the sides of the excavations to avoid the imposition of additional loads, unless these loads are considered in the design of the temporary shoring or side slopes. Additionally, the effect of excavation machinery should be included in the stability of the open cut slopes, as well as the temporary shoring design.

A portion of the on-site soils are sensitive to moisture and are subject to disturbance and deterioration due to weather, moisture intrusion, and construction traffic, etc. It is recommended that excavation equipment operating from the existing ground surface be utilized to complete the proposed excavations.

If soil subgrades within the excavation are to be left open for a prolonged period, a working mat should be used to protect the foundation subgrade. A working mat may consist of a layer of ¾-inch quarry processed crushed stone, dense graded aggregate, a two-inch lean concrete "mud mat," or other approved material, which will serve to prevent subgrade softening if the subgrade is exposed for prolonged periods.

Excavated granular soils approved by the Geotechnical Engineer may be stockpiled on-site for use as a component of the backfill material. The moisture content will have to be kept as close as possible to the optimum moisture content of this material, if it is to be placed successfully as controlled fill.

Backfill

A portion of the on-site soils contain a high percentage of fine-grained material and are sensitive to moisture which may make them difficult to compact. Therefore, these soils are not suitable for use as controlled structural fill. However, they can be used as non-structural fill to raise grades outside of the building envelope and in any paved areas provided, they can be placed at a moisture content which would permit compaction to the required densities. The clean granular portions of the existing on-site soils can be reused as backfill after approval by the Geotechnical Engineer. Soils with organic or other deleterious materials should be discarded. The moisture content of the soil must be within 2% of the optimum value for proper compaction. Therefore, some adjustment of the moisture content may be necessary prior to use as fill material. If imported fill materials are required to complete backfilling of the excavations, they

should consist of uncontaminated, relatively well-graded granular soils as defined in Item 5 of the Site Preparation & Earthwork Operations portion of this report.

Backfilling against the foundations and for utility trenches, or other structural uses, should be accomplished using controlled structural fill, as defined in this report, compacted to 95% of the maximum dry density as determined by the Modified Proctor Test, ASTM D 1557. Compaction of the backfill within 5 ft of any existing structures should be carried out with relatively light equipment such as a jumping jack, a walk behind roller, or similar device as approved by the on-site representative of the Geotechnical Engineer. The backfill should be placed in 8-inch lifts and compacted to at least 95% and 90% of maximum dry density, as determined by the ASTM D-1557 test procedure, in structural areas and in paved or landscaped areas, respectively.

Dewatering

Groundwater was encountered in only three (3) borings at depths ranging from 8 to 11 feet below existing grade at the time of our drilling operation. Therefore, we do not anticipate major groundwater problems in excavations for this project. Minor seepage may be encountered in relatively shallow excavations due to perched water conditions. Dewatering of perched water, run-off water, or any water encountered during construction can be performed using sump pumps and screened sumps.

Foundations

After site preparation operations have been satisfactorily completed, as recommended herein, the densified on-site natural soils and/or structural fill may be utilized to support the proposed structure using a shallow foundation system. Continuous wall footings and isolated column footings may be used. For design purposes, at a depth of 3 feet below existing grade a maximum net allowable bearing pressure of 3,000 pounds per square foot (psf) can be used. With the use of the recommended allowable bearing capacity, a satisfactory factor of safety will be provided against a shear failure and total and differential settlement will be within tolerable limits.

Wall and column footing widths should not be less than 2 and 3 feet, respectively. Exterior footings should be founded at a minimum depth of 3 feet beneath the exterior finished grades for frost protection. Interior footings in heated areas of the building can be founded at any convenient depth provided that the bottom of the floor slab and top of the concrete footings are separated by a minimum 6-inch thick layer of clean structural fill or granular base material. In the vicinity of any existing structures, the proposed foundation bottom elevation should be the same as that of the existing foundation. It should be pointed out that in no case should a line drawn at a 1.5H:1V

slope from the nearest edges of the proposed foundation bottom elevation intersect with any existing foundations, and vise versa. If any adjacent foundations are above the proposed new footing founding level, and the 1.5H:1V slope intersects the new foundations, the existing foundations must be underpinned to prevent undermining the existing foundations or slabs.

The footing subgrades should be rigorously compacted prior to the placement of the concrete utilizing a mechanical compactor such as a jumping jack, walk-behind roller, or similar device as approved by the on-site representative of the Geotechnical Engineer. A portion of the on-site soils contain a relatively high silt and clay content and are very sensitive to moisture. We, therefore, recommend that footing concrete be placed as soon as the excavation is opened and approved. If, however, the excavation is to be left open for a prolonged period, a work mat should be used to protect the foundation subgrade. A work mat may consist of 6 inches of compacted dense grade aggregate or 2 inches of lean concrete.

Prior to the placement of concrete, the foundation subgrade must be inspected by a qualified representative of the Geotechnical Engineer in order to confirm the soil bearing capacity. The contractor should exercise extreme caution not to disturb the subgrade soils. Should the subgrade be disturbed, the loosened soil should be compacted in-place or excavated down to firm soil. Any water, which accumulates in the excavation bottom, should be removed promptly.

Floor Slabs

Proposed reinforced concrete floor slabs can be uniformly supported on the densified natural soil or controlled structural fill after site preparation procedures have been successfully completed as discussed herein. The slabs should be structurally independent of walls and footings. Large floor areas should be provided with joints at frequent intervals as determined by the structural engineer. A minimum of 4 inches of ¾-inch clean crushed stone or a 12-inch thick layer (minimum) of well-graded sand and gravel with not more than 5% non-plastic fines is recommended below the slab to assure uniform bearing conditions and to act as a capillary break. A vapor barrier should be placed between the slab and base course, as directed by the Architect, to minimize moisture migration to the surface. All structural fill supporting the floor slab should be compacted to 95% of the maximum dry density (ASTM D 1557).

Concrete slabs placed on the subgrade, prepared as described herein, can be designed using a modulus of subgrade reaction of 200 pounds per cubic inch (pci).

Seismic Zone

According to the New Jersey Edition of the 2021 International Building Code, Section 1613.2.2 referencing ASCE 7, Chapter 20 the project site is categorized as a Site Class "D" for seismic design purposes. Attached are seismic design values based on a Risk Category 3 for the structure and for site class "D". This classification is based on the soil conditions encountered in the boring.

LIMITATIONS

The conclusions and recommendations contained in this report are based upon the subsurface data obtained during this investigation and on details stated in this report. It is understood that the number of borings made are consistent with good engineering practice, but actual conditions encountered may differ significantly from those projected in this report. Should conditions arise which differ from those described in this report, **RVE** should be notified immediately and provided with all information regarding differing subsurface conditions.

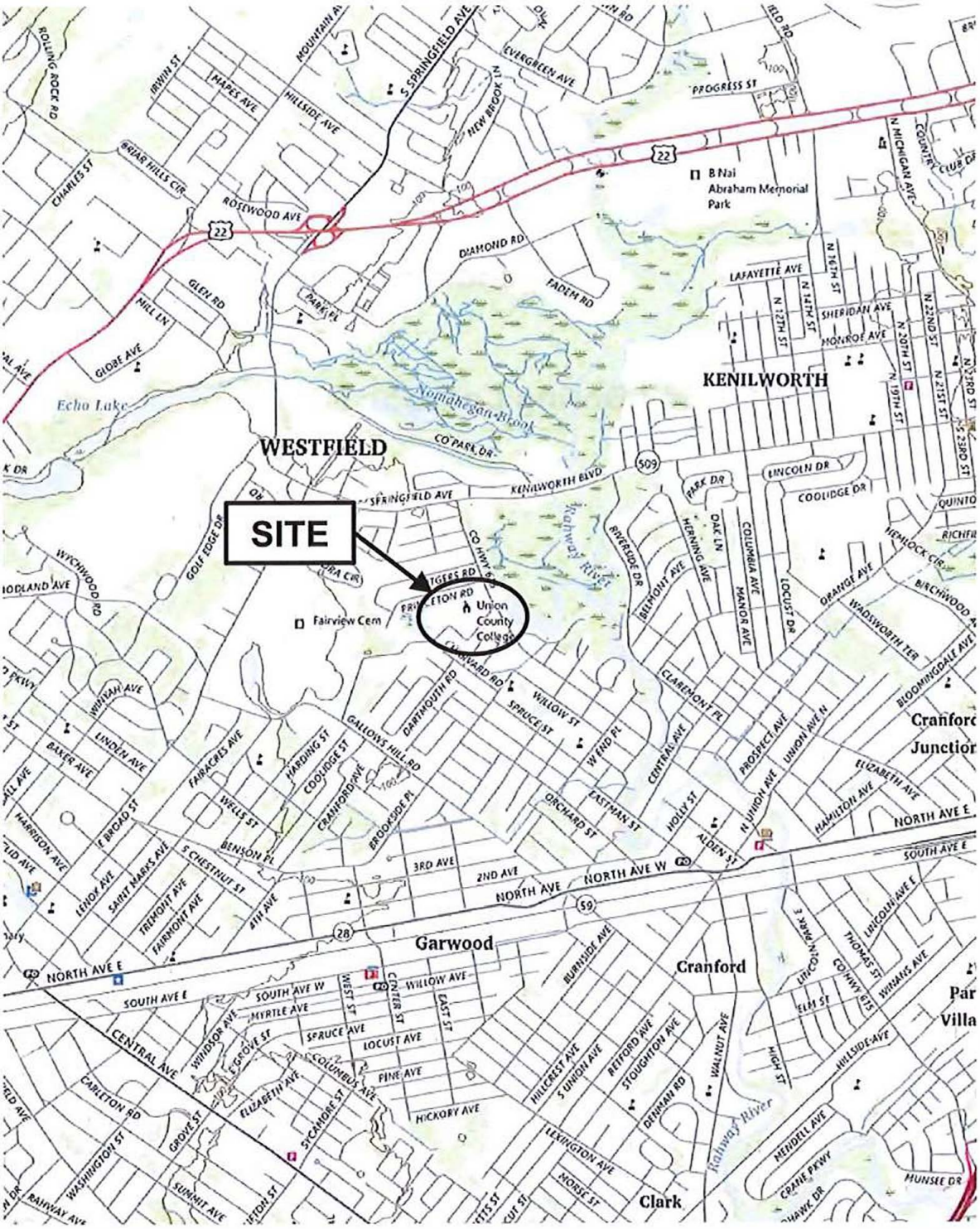
Our recommendations are based upon the assumption that the services of a qualified Geotechnical Engineer will be retained during construction for the observation of all critical earthwork operations and foundation installation. **RVE** cannot minimize, or provide recommended solutions for, any problems resulting from construction or differing soil conditions unless our services include full-time construction inspection to determine that the work performed is in compliance with **RVE's** recommendations, and to ensure the work is carried out in the owner's best interests.

Environmental considerations and contaminants, such as petroleum products, hazardous waste, radioactivity, irritants, pollutants, radon or other dangerous substances and conditions were not the subject of this study. Their presence and/or absence are not implied, inferred or suggested by this report or results of this study.

This report is intended for use with regard to the specific project discussed herein, and any changes in the design of the structure or location, however slight, should be brought to our attention so that we may determine how they may affect our conclusions. We are responsible for the conclusions and opinions contained in this report based on the data relating only to the specific project and location discussed herein.

Appendix A

Site Location Map/USGS Quadrangle



Site Location Map/USGS Quadrangle

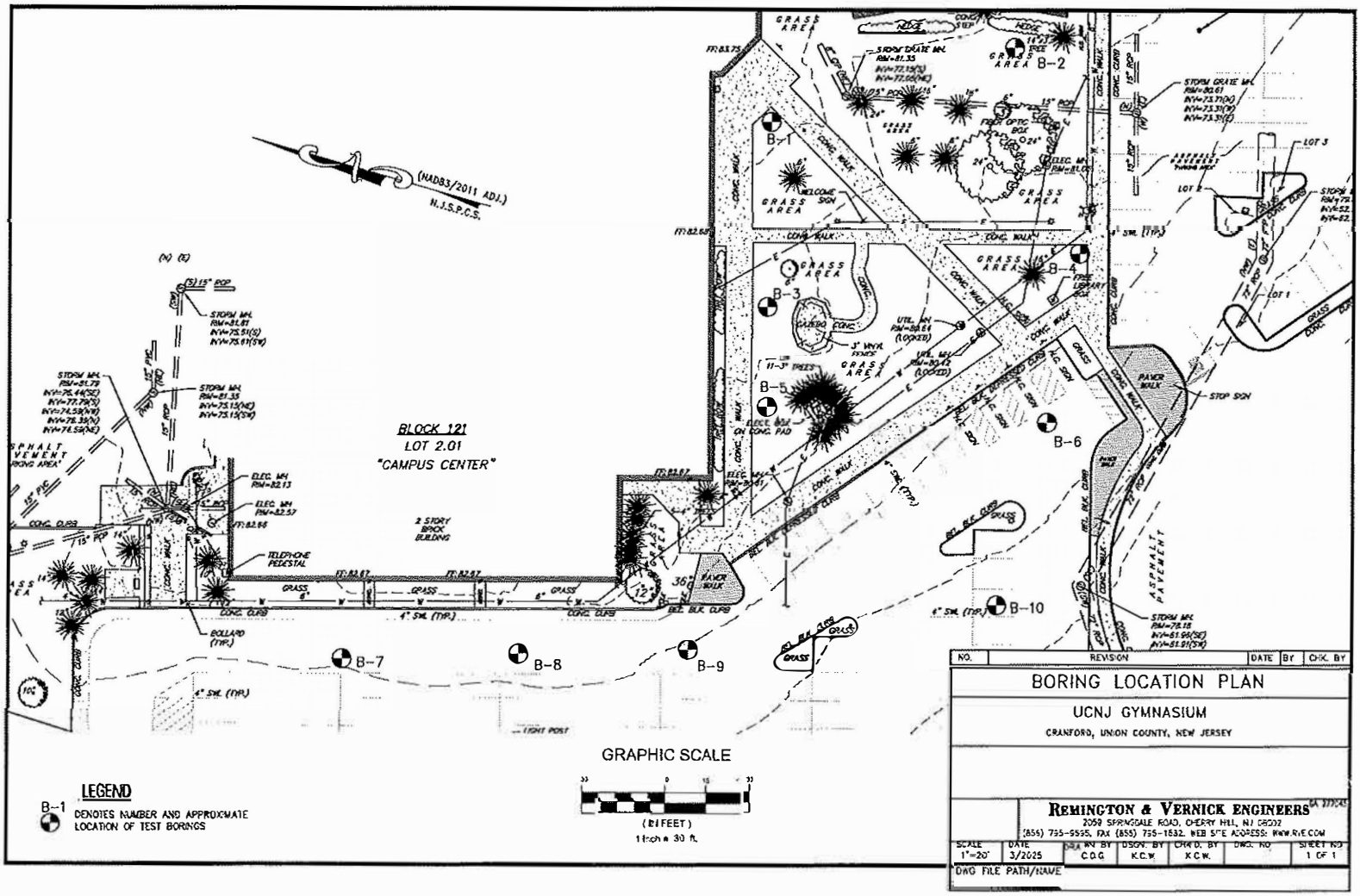
Gymnasium Addition

UCNJ Union College of Union County – Cranford Campus

Cranford, Union County, New Jersey

Appendix B

Soil Boring Location Plan



LEGEND

B-1 DENOTES NUMBER AND APPROXIMATE LOCATION OF TEST BORINGS

NO.	REVISION	DATE	BY	CHK. BY

BORING LOCATION PLAN

UCNJ GYMNASIUM

CRANFORD, UNION COUNTY, NEW JERSEY

REMINGTON & VERNICK ENGINEERS
2059 SPRINGDALE ROAD, CHERRY HILL, NJ 08003
(856) 795-9595, FAX (856) 795-1882, WEB SITE ADDRESS: WWW.RVE.COM

SCALE	DATE	DRN. BY	DSGN. BY	CHK'D. BY	DWG. NO.	SHEET NO.
1"=20'	3/2025	C.O.G.	K.C.W.	K.C.W.		1 OF 1

DWG FILE PATH/NAME

Appendix C

Soil Boring Logs

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-1

Date Started: 2/28/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/28/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** 11 ft

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/28/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0		S-1	2-4-6-5	10"		3" Topsoil over reddish brown CLAYEY SILT, little m-f Sand, trace f Crushed Stone (Fill)			
		S-2	6-7-8-8	18"		Reddish brown SILT, little f Sand, trace Clay			
5		S-3	6-7-7-7	18"					
		S-4	7-8-8-7	20"					
		S-5	5-6-5-6	18"					
10		S-6	4-3-6-6	18"					
15		S-7	9-10-10-14	10"		Reddish brown c-f SAND, trace Silt, trace Clay			
20		S-8	17-17-19-32	14"		Reddish brown c-f SAND, some m-f Gravel, trace Silt, trace Clay			
25		S-9	5-4-9-11	NR		Rock Fragment in Tip			
						Boring End at 27 feet			
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-2

Date Started: 2/28/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/28/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** 8 ft

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/28/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0		S-1	3-8-9-10	16"		3" topsoil over reddish brown SILT over 2" CRUSHED STONE over reddish brown CLAYEY SILT, little f Sand (Fill)			
		S-2	6-8-11-15	14"		Reddish brown c-f SAND, little Silt, little f Crushed Stone, trace Clay (Fill)			
5		S-3	5-10-10-9	18"		Reddish brown f SAND, some Silt, trace Clay			
		S-4	5-5-6-7	14"		Reddish brown SILT, little Clay, trace f Sand			
		S-5	5-5-7-9	18"		Reddish brown SILT, little Clay, little f Sand			
10		S-6	9-10-16-12	18"					
15		S-7	7-12-15-19	20"		Reddish brown m-f SAND, trace Silt			
20		S-8	14-22-28-30	18"		Reddish brown c-f SAND, little m-f Gravel, little m-f Rock Fragments, trace Silt, trace Clay			
25		S-9	10-11-13-13	16"					
						Boring End at 27 Feet			
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-3

Date Started: 2/28/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/28/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** 8 ft

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/28/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0		S-1	3-6-4-9	12"		3" topsoil over reddish brown CLAYEY SILT, trace m-f Crushed Stone, trace f Sand			
		S-2	5-15-17-10	14"		Reddish brown SILT, little Clay, trace m-f Crushed Stone, trace f Sand (Fill)			
5		S-3	10-14-22-13	8"		Reddish brown m-f SAND, little m-f Crushed Stone, trace Silt (Fill)			
		S-4	11-8-10-10	12"		Reddish brown m-f SAND, little Silt, little Clay, little m-f Gravel			
		S-5	2-3-9-25	12"		Reddish brown SILT, some f Sand, trace Clay, trace f Gravel			
10		S-6	16-17-16-32	18"		Reddish brown m-f SAND, little CLay, little m-f Rock Fragments, trace Clay			
15		S-7	8-16-18-14	16"		Reddish brown m-f SAND, trace f Gravel, trace Silt			
20		S-8	13-24-25-28	18"		Reddish brown c-f SAND, some m-f Gravel & Rock Fragments, trace Silt, trace Clay			
25		S-9	9-14-14-15	18"		Reddish brown c-f SAND, some m-f Rock Fragments, trace Silt, trace Clay			
						Boring End at 27 Feet			
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-4

Date Started: 2/27/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/27/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** None

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/27/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0		S-1	2-5-5-7	12"		3" topsoil over reddish brown SILT, little f Sand, little Clay, trace f Crushed Stone (Fill)			
		S-2	5-5-6-4	12"		Reddish brown SILT, little f Sand, little Clay (Possible Fill)			
5		S-3	6-6-4-6	12"		Reddish brown SILT, little f Sand, little Clay			
		S-4	2-4-3-6	18"		Reddish brown SILT, little Clay, trace f Gravel			
		S-5	8-8-7-5	6"					
10		S-6	5-6-5-7	16"		Reddish brown SILT, little f Sand, little Clay			
15		S-7	18-23-24-23	16"		Reddish brown c-f SAND, little Silt, little m-f Gravel, trace Clay			
20		S-8	23-17-17-18	20"					
25		S-9	12-8-6-11	10"					
						Boring end at 27 feet			
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-5

Date Started: 2/27/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/27/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** None

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/27/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0		S-1	4-4-6-5	16"		3" topsoil over reddish brown & gray SILT, little f Sand, little Clay, trace f Crushed Stone (Fill)			
		S-2	12-8-12-12	20"		Reddish brown SILT, little f Sand, trace Clay			
5		S-3	13-11-11-10	16"		Reddish brown SILT, some f Sand, trace Clay			
		S-4	3-2-5-10	20"		Reddish brown SILT & m-f SAND, little Clay, trace f Gravel			
		S-5	6-5-7-11	16"					
10		S-6	13-18-20-16	16"		Reddish brown c-f SAND, some m-f Gravel, trace Silt, trace Clay			
15		S-7	9-15-13-17	16"		Reddish brown f SAND, little Silt, little Clay, trace f Gravel			
20		S-8	20-23-22-19	18"		Reddish brown c-f SAND, some m-f Gravel, trace Silt, trace Clay			
25		S-9	22-11-11-17	16"		Reddish brown SILT, little Clay, little f Sand			
						Boring end at 27 feet			
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-6

Date Started: 2/27/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/27/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** None

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/27/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0			AUGER			6" Asphalt Pavement			
		S-1	2-3-3	12"		Gray & reddish brown SILT, little f Sand, trace Clay (Fill)			
		S-2	10-11-15-13	NR					
5		S-3	20-16-13-15	12"		6" m-f Crushed Stone over reddish brown f SAND, little m-f Crushed Stone, trace Silt, trace Clay (Fill)			
		S-4	19-12-13-13	12"		Reddish brown SILT, little f Sand, little Clay			
		S-5	4-3-7-11	10"					
10		S-6	4-5-7-7	14"		Reddish brown SILT, little f Sand, trace Clay			
15		S-7	6-10-20-26	10"		Reddish brown c-f SAND, little Silt, little f Gravel, trace Clay			
20		S-8	18-19-18-27	16"		Reddish brown c-f SAND, some m-f Gravel, little f Rock Fragments			
25		S-9	19-15-11-13	10"		Brown & reddish brown c-f SAND, little f Gravel, trace Silt			
						Boring End at 27 feet			
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-7

Date Started: 2/26/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/26/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** None

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/26/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0			AUGER			6" Asphalt Pavement			
		S-1	25-7-8	18"		6" Crushed Stone Subbase over reddish brown m-f SAND, little Silt, trace Clay, trace f Crushed Stone (Fill)			
		S-2	5-5-7-7	16"		Reddish brown f SAND, little Silt, trace Clay			
5		S-3	5-9-9-9	12"		Reddish brown f SAND, little Silt, trace Clay, trace m-f Gravel			
		S-4	2-3-7-6	12"		Reddish brmf SAND & SILT, little m-f Gravel, little Clay			
		S-5	11-13-18-24	18"		Reddish brown f SAND, little m-f Rock Fragments, little Silt, trace Clay			
10		S-6	4-5-10-17	18"		Reddish brown SILT, little Clay, little m-f Gravel, trace f Sand			
15		S-7	15-11-12-18	18"		Reddish brown c-f SAND, some m-f Gravel, trace Silt, trace Clay			
20		S-8	18-25-23-23	20"					
25		S-9	9-4-11-14	6"		Reddish brown m-f GRAVEL, little c-f Sand			
						Boring End at 27 feet			
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-8

Date Started: 2/26/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/26/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** None

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/26/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** 2/26/25

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0			AUGER			6" Asphalt Pavement			
		S-1	10-9-6	12"		Brown & gray c-f SAND, little m-f Crushed Stone, trace Silt (Fill)			
		S-2	5-3-4-5	16"		Reddish brown CLAYEY SILT, little f Sand			
5		S-3	8-15-11-8	12"		Reddish brown m-f SAND, little m-f Rock Fragments, trace Silt, trace Clay			
		S-4	2-6-7-12	20"		Reddish brown SILT, little f Sand, little Clay, trace f Gravel			
		S-5	8-10-22-14	20"		Reddish brown m-f SAND, little Silt, little m-f Gravel, trace Clay			
10		S-6	15-17-18-25	18"		Reddish brown SILT, little m-f Gravel, little f Sand, little Clay			
15		S-7	8-10-14-16	12"		Reddish brown c-f SAND, some f Gravel, trace Silt, trace Clay			
20		S-8	12-14-16-19	18"		Reddish brown c-f SAND, some m-f Gravel, trace Silt			
25		S-9	11-14-10-16	20"		Reddish brown c-f SAND, little Clayey Silt, little f Gravel			
						Reddish brown CLAYEY SILT, little f Sand			
						Boring end at 27 feet			
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-9

Date Started: 2/26/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/26/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** None

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/26/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0			AUGER			6" Asphalt Pavement			
		S-1	8-2-2	8"		Gray c-f SAND & f CRUSHED STONE (Fill)			
		S-2	2-2-3-3	12"		Reddish brown CLAYEY SILT, little f Sand, trace f Crushed Stone (Fill)			
5		S-3	2-3-3-4	20"		Reddish brown m-f SAND, some Silt, little Clay			
		S-4	6-6-8-8	16"		Reddish brown SILT, little f Sand, trace Clay, trace m-f Gravel			
		S-5	2-12-9-9	10"		Reddish brown SILT, little Clay, trace f Sand			
10		S-6	7-9-12-13	16"		Reddish brown SILT, little Clay, little f Gravel, trace f Sand			
15		S-7	6-10-12-12	20"		Reddish brown m-f SAND, some m-f Gravel, some Silt, little Clay			
20		S-8	25-30-24-22	10"		Reddish brown CLAYEY SILT, some c-f Sand, little m-f Gravel			
25		S-9	25-30-24-22	10"					
						Boring End at 27 feet			
30									
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 4030-X-002 **Project** UCNJ Gymnasium Addition - Cranford Campus **Boring No.** B-10

Date Started: 2/27/25 **Location** 1033 Springfield Avenue, Cranford, NJ 07016 **Sheet** 1 **of** 1

Date Finished: 2/27/25 **Client** DI Group Architecture **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers Inc. **Groundwater Data**

Drilling Method: Washed Boring Method **Depth** None

Hammer Type: Automatic **Driller:** Mike Beveridge **Date** 2/27/25

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0			AUGER			6" Asphalt Pavement			
		S-1	35-11-8	10"		6" crushed stone subbase over reddish brown f SAND, little m-f Crushed Stone, trace Silt, trace Clay			
		S-2	6-6-14-8	18"		Reddish brown CLAYEY SILT, some f Sand, little m-f Crushed Stone (Fill)			
5		S-3	6-6-8-9	20"		Reddish brown SILT & m-f SAND, little Clay, trace f Gravel (Fill)			
		S-4	15-20-15-14	10"		Brown & reddish brown SILT, some f Sand, trace Clay, trace f Crushed Stone (Fill)			
		S-5	10-12-11-10	18"		Reddish brown CLAYEY SILT, little Clay, little f Sand			
10		S-6	6-5-6-11	4"					
15		S-7	5-9-5-5	16"		Reddish brown c-f SAND, little Silt, little Clay, little f Gravel			
20		S-8	16-18-21-28	10"		Reddish brown m-f ROCK FRAGMENTS, little c-f Sand, trace Silt, trace Clay			
25		S-9	27-33-25-26	18"		Reddish brown c-f SAND, little Silt, little m-f Gravel & Rock Fragments, trace Clay			
						Boring End at 27 Feet			
30									
35									

MODIFIED METHOD
FOR
IDENTIFICATION OF SOILS
AFTER
DR. D. M. BURMISTER

Soil Component	Descriptive Terms As Written on Log	Range of Proportions
PRINCIPAL COMPONENT (All Letters Capitalized)	-	35% or more
MINOR COMPONENTS (First Letter Capitalized)	and (a.)	35% to 50%
	some (s.)	20% to 35%
	little (l.)	10% to 20%
	trace (tr.)	1% to 10%

Coarse Grained Soils-Gradation of Components

Coarse to fine	cf	All sizes
Coarse to medium	cm	Less than 10% fine
Medium to fine	mf	Less than 10% coarse
Coarse	c	Less than 10% medium & fine
Medium	m	Less than 10% coarse & fine
Fine	f	Less than 10% coarse & medium

Component	Symbol	Sieve Range
Boulders		9" and larger
Cobbles		3" to 9"
Gravel	G	
Coarse		¾" to 3"
Fine		#4 to ¾"
Sand	S	
Coarse		#4 to #10
Medium		#10 to #40
Fine		#40 to #200

Fine Grained Soils-Plasticity of Components

Component	Symbol	Overall Plasticity	Plasticity Index
SILT	S	Non-Plastic	0
CLAYEY SILT	CyS	Slight	1 to 5
SILT & CLAY	S & C	Low	5 to 10
CLAY & SILT	C & S	Medium	10 to 20
SILTY CLAY	SyC	High	20 to 40
CLAY	C	Very High	over 40

UNIFIED SOIL CLASSIFICATION SYSTEM. (ASTM D-2487)

Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 per cent: GW, GP, SW, SP; More than 12 per cent: GM, GC, SM, SC; 5 to 12 per cent: *Borderline* cases requiring dual symbols[b]
			GP	Poorly graded gravels, gravel-sand mix-tures, little or no fines	
		Gravels with fines (Appreciable amount of fines)	GM[a] d / u	Silty gravels, gravel-sand-silt mixtures	
			GC	Clayey gravels, gravel-sand-clay mix-tures	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	
			SP	Poorly graded sands, gravelly sands, little or no fines	
		Sands with fines (Appreciable amount of fines)	SM[a] d / u	Silty sands, sand-silt mixtures	
			SC	Clayey sands, sand-clay mixtures	
Fine-grained soils (More than half material is smaller than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity, organic silts	
	Highly organic soils		Pt	Peat and other highly organic soils	

$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3

Not meeting all gradation requirements for GW

Atterberg limits below "A" line or P.I. Less than 4 — Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols

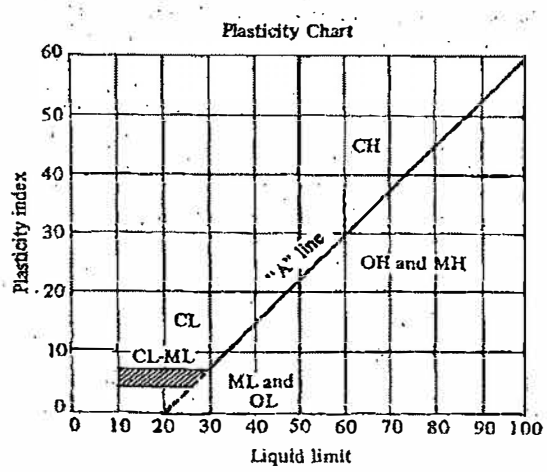
Atterberg limits below "A" line with P.I. Greater than 7

$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3

Not meeting all gradation requirements for SW

Atterberg limits above "A" line or P.I. Less than 4 — Limits plotting in hatched zone with P.I. Between 4 and 7 are *borderline* cases requiring use of dual symbols

Atterberg limits above "A" line with P.I. Greater than 7



[a]Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

[b]Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

Appendix D

Normalized N-Values

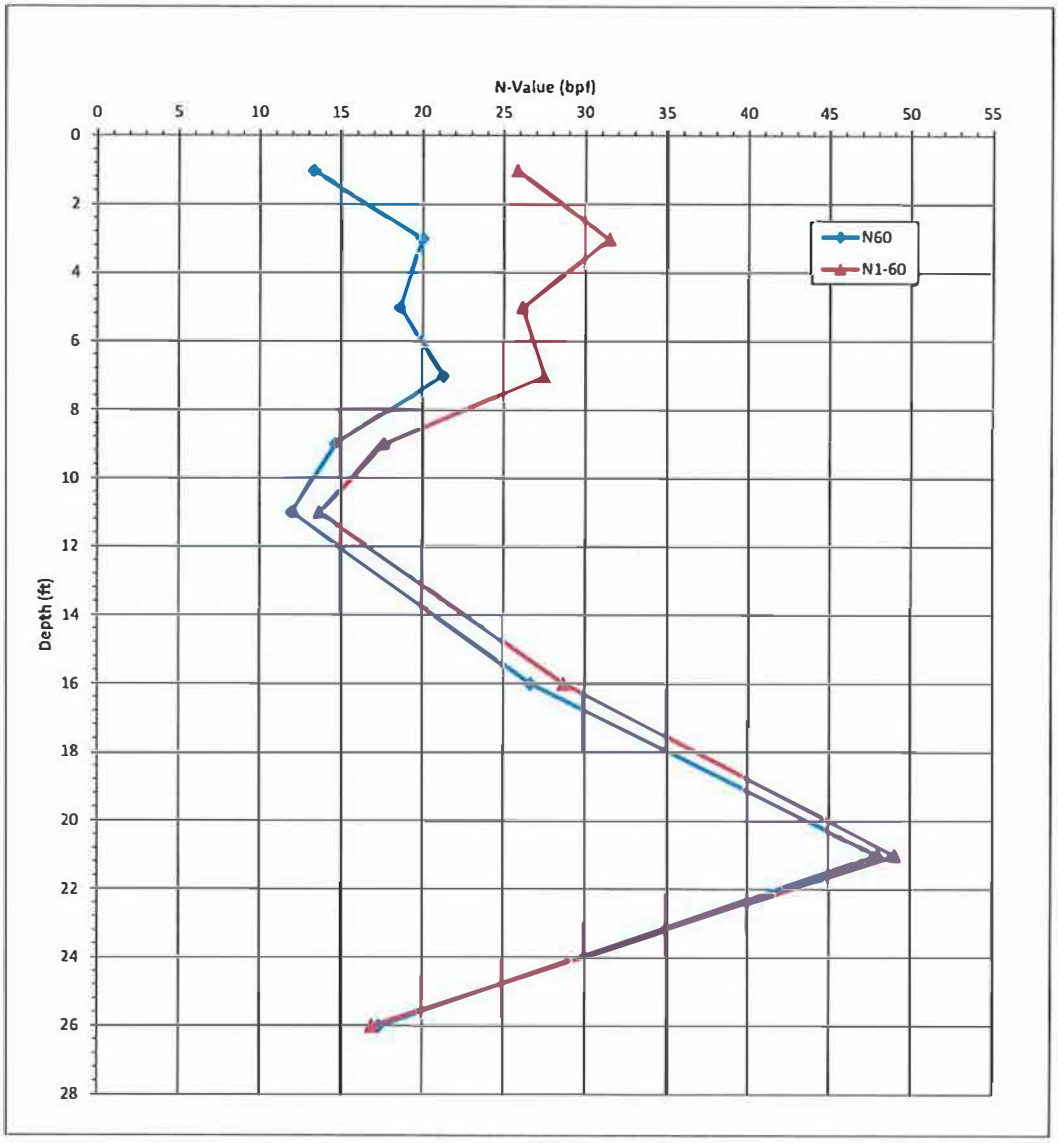
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	B-1
Elevation, ft	0
Groundwater Depth, ft	11
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)
	σ' = σt - u
	CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf
	N160 = N60*CN

Sample Number	Sample Depth	N-value Recorded Depth	Elev.	Value	N_{60}	γ pcf	σt ksf	u ksf	σ' ksf	CN	N160
1	0 - 2	1	-1	10	13	120	0.12	0.00	0.12	1.94	26
2	2 - 4	3	-3	15	20	120	0.36	0.00	0.36	1.58	32
3	4 - 6	5	-5	14	19	120	0.60	0.00	0.60	1.40	26
4	6 - 8	7	-7	16	21	120	0.84	0.00	0.84	1.29	28
5	8 - 10	9	-9	11	15	120	1.08	0.00	1.08	1.21	18
6	10 - 12	11	-11	9	12	120	1.32	0.00	1.32	1.14	14
7	15 - 17	16	-16	20	27	120	1.92	0.32	1.60	1.08	29
8	20 - 22	21	-21	36	48	120	2.52	0.64	1.88	1.02	49
9	25 - 27	26	-26	13	17	121	3.13	0.96	2.16	0.98	17



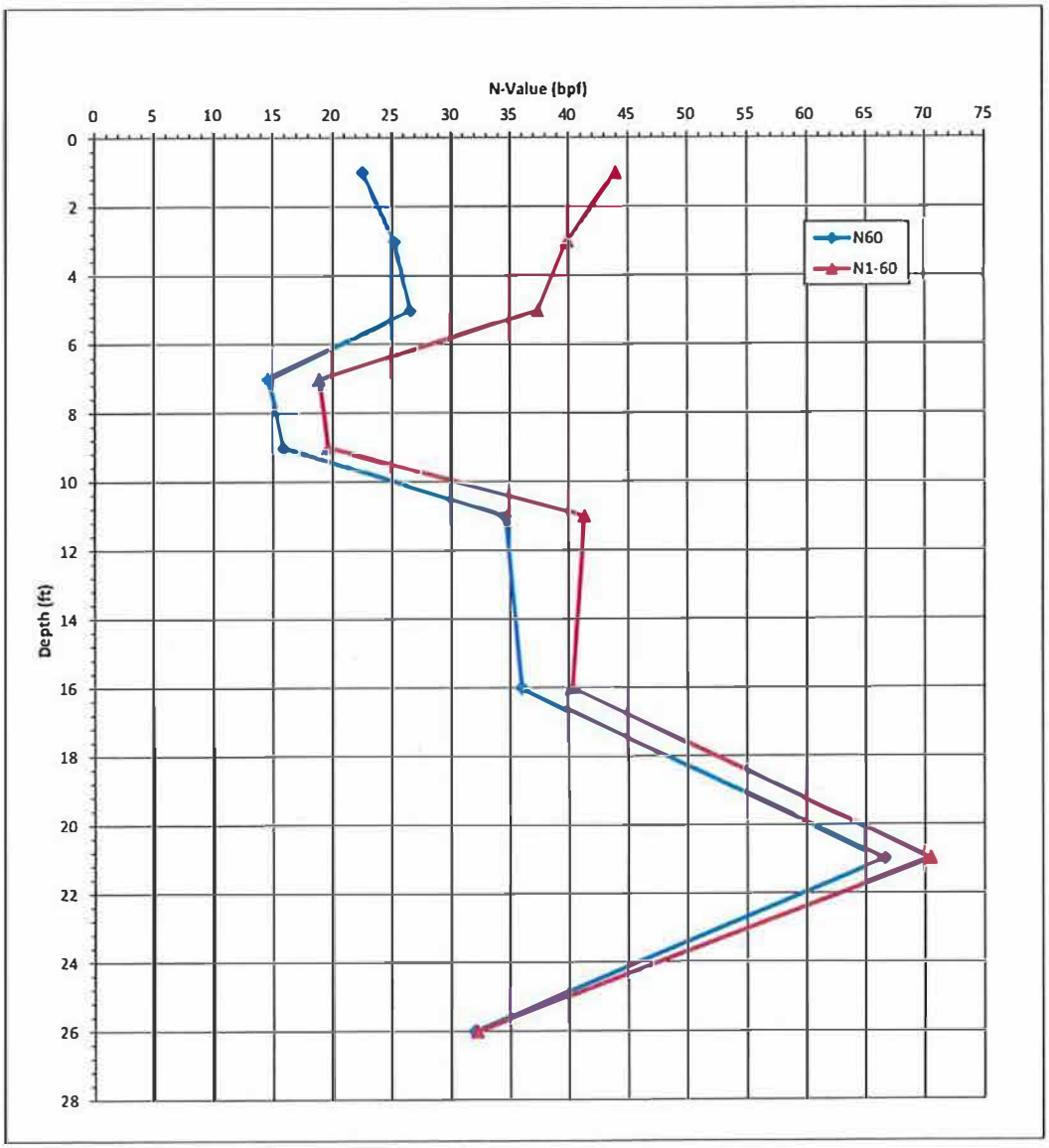
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	B-2
Elevation, ft	0
Groundwater Depth, ft	8
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)
	σ' = σt - u
	CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf
	N160 = N60*CN

Sample Number	Sample Depth	N-value Recorded			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	17	23	120	0.12	0.00	0.12	1.94	44
2	2 - 4	3	-3	19	25	120	0.36	0.00	0.36	1.58	40
3	4 - 6	5	-5	20	27	120	0.60	0.00	0.60	1.40	37
4	6 - 8	7	-7	11	15	120	0.84	0.00	0.84	1.29	19
5	8 - 10	9	-9	12	16	120	1.08	0.06	1.02	1.23	20
6	10 - 12	11	-11	26	35	120	1.32	0.19	1.13	1.19	41
7	15 - 17	16	-16	27	36	120	1.92	0.51	1.41	1.12	40
8	20 - 22	21	-21	50	67	120	2.52	0.83	1.69	1.06	71
9	25 - 27	26	-26	24	32	121	3.13	1.16	1.97	1.01	32



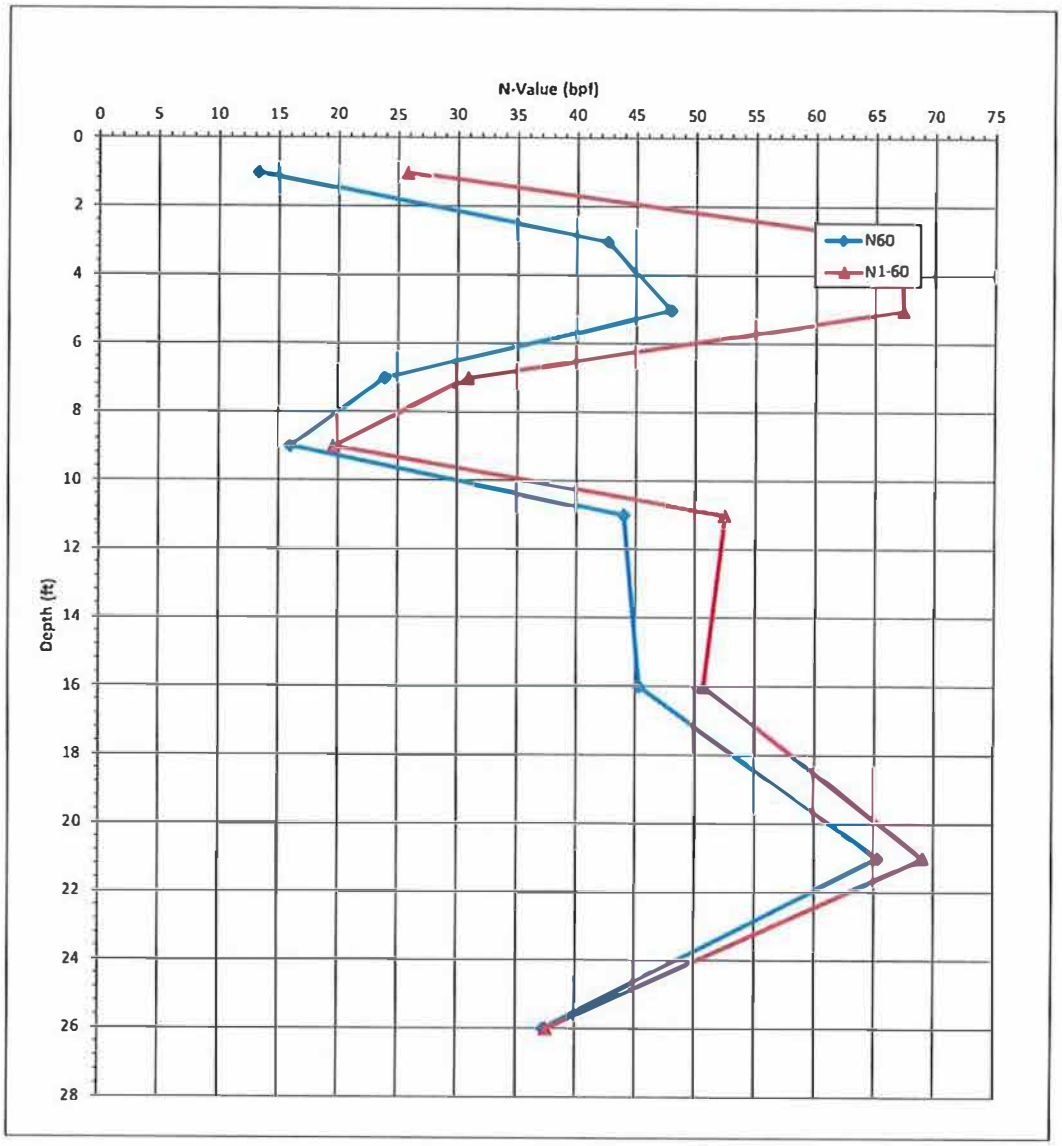
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	B-3
Elevation, ft	0
Groundwater Depth, ft	8
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6) σ' = σt - u CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf N160 = N60*CN

Sample Number	Sample Depth	N-value Recorded			N_{60}	γ pcf	σt ksf	u ksf	σ' ksf	CN	N160
		Depth	Elev.	Value							
1	0 - 2	1	-1	10	13	120	0.12	0.00	0.12	1.94	26
2	2 - 4	3	-3	32	43	120	0.36	0.00	0.36	1.58	67
3	4 - 6	5	-5	36	48	120	0.60	0.00	0.60	1.40	67
4	6 - 8	7	-7	18	24	120	0.84	0.00	0.84	1.29	31
5	8 - 10	9	-9	12	16	120	1.08	0.06	1.02	1.23	20
6	10 - 12	11	-11	33	44	120	1.32	0.19	1.13	1.19	53
7	15 - 17	16	-16	34	45	120	1.92	0.51	1.41	1.12	51
8	20 - 22	21	-21	49	65	120	2.52	0.83	1.69	1.06	69
9	25 - 27	26	-26	28	37	121	3.13	1.16	1.97	1.01	38



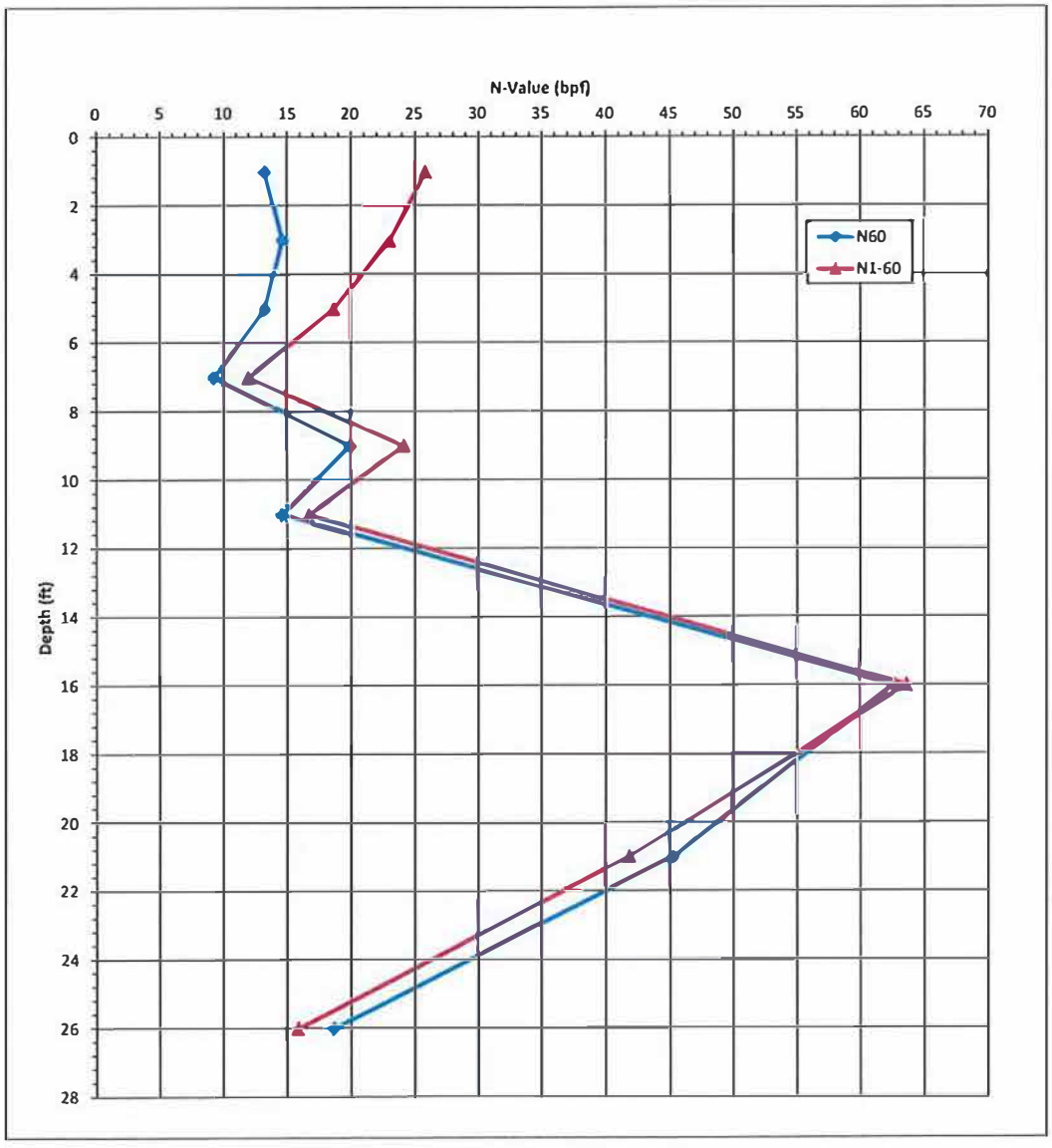
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	B-4
Elevation, ft	0
Groundwater Depth, ft	None
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6) σ' = σt - u CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf N160 = N60*CN

Sample Number	Sample Depth	N-value Recorded			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	10	13	120	0.12	0.00	0.12	1.94	26
2	2 - 4	3	-3	11	15	120	0.36	0.00	0.36	1.58	23
3	4 - 6	5	-5	10	13	120	0.60	0.00	0.60	1.40	19
4	6 - 8	7	-7	7	9	120	0.84	0.00	0.84	1.29	12
5	8 - 10	9	-9	15	20	120	1.08	0.00	1.08	1.21	24
6	10 - 12	11	-11	11	15	120	1.32	0.00	1.32	1.14	17
7	15 - 17	16	-16	47	63	120	1.92	0.00	1.92	1.02	64
8	20 - 22	21	-21	34	45	120	2.52	0.00	2.52	0.92	42
9	25 - 27	26	-26	14	19	121	3.13	0.00	3.13	0.85	16



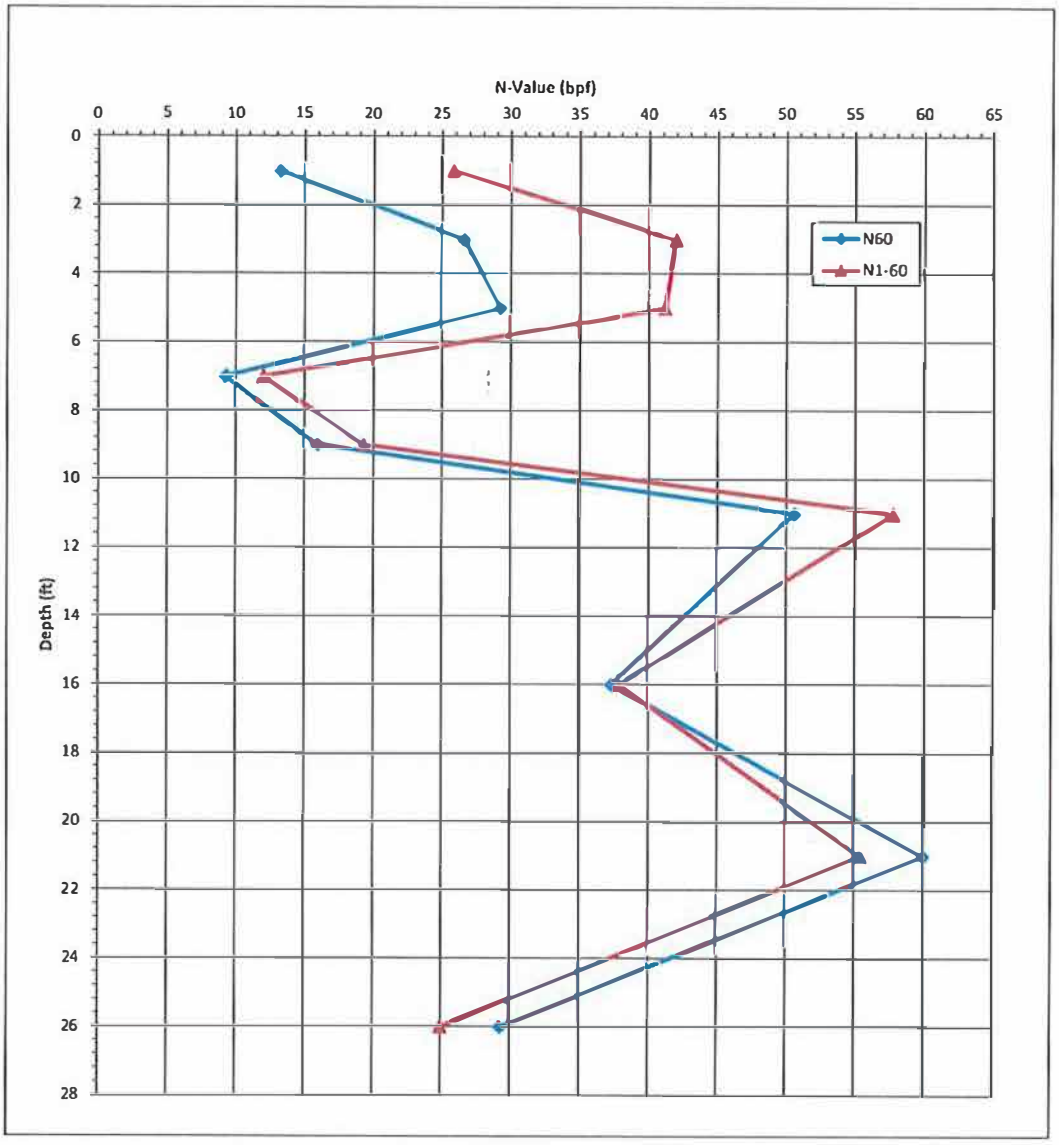
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	B-5
Elevation, ft	0
Groundwater Depth, ft	None
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6) σ' = σt - u CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf N160 = N60*CN

Sample Number	Sample Depth	N-value Recorded Depth	Elev.	Value	N_{60}	γ pcf	σt ksf	u ksf	σ' ksf	CN	N160
1	0 - 2	1	-1	10	13	120	0.12	0.00	0.12	1.94	26
2	2 - 4	3	-3	20	27	120	0.36	0.00	0.36	1.58	42
3	4 - 6	5	-5	22	29	120	0.60	0.00	0.60	1.40	41
4	6 - 8	7	-7	7	9	120	0.84	0.00	0.84	1.29	12
5	8 - 10	9	-9	12	16	120	1.08	0.00	1.08	1.21	19
6	10 - 12	11	-11	38	51	120	1.32	0.00	1.32	1.14	58
7	15 - 17	16	-16	28	37	120	1.92	0.00	1.92	1.02	38
8	20 - 22	21	-21	45	60	120	2.52	0.00	2.52	0.92	55
9	25 - 27	26	-26	22	29	121	3.13	0.00	3.13	0.85	25



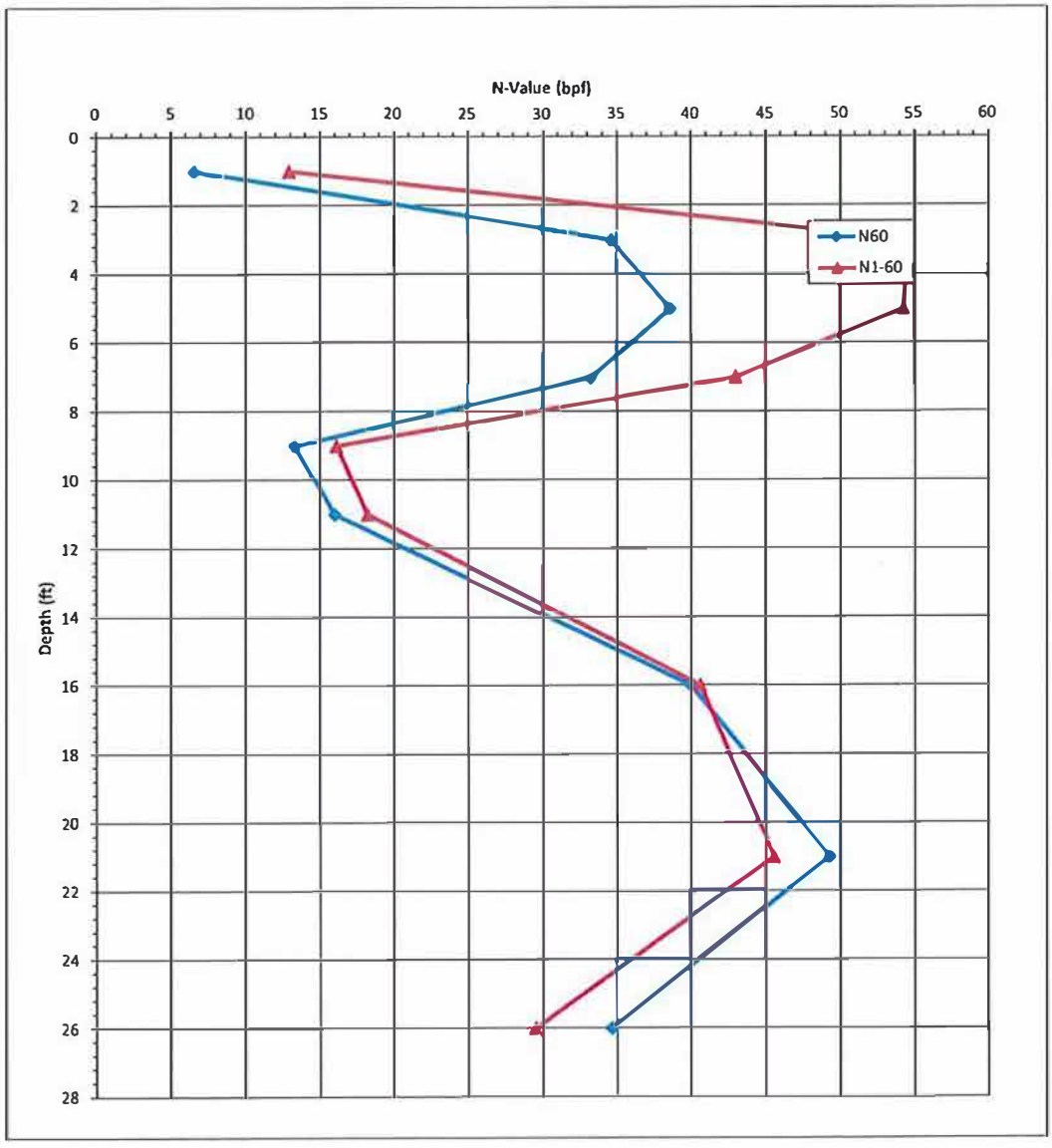
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	B-6
Elevation, ft	0
Groundwater Depth, ft	None
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6) σ' = σt - u CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf N160 = N60*CN

Sample Number	Sample Depth	N-value Recorded			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	5	7	120	0.12	0.00	0.12	1.94	13
2	2 - 4	3	-3	26	35	120	0.36	0.00	0.36	1.58	55
3	4 - 6	5	-5	29	39	120	0.60	0.00	0.60	1.40	54
4	6 - 8	7	-7	25	33	120	0.84	0.00	0.84	1.29	43
5	8 - 10	9	-9	10	13	120	1.08	0.00	1.08	1.21	16
6	10 - 12	11	-11	12	16	120	1.32	0.00	1.32	1.14	18
7	15 - 17	16	-16	30	40	120	1.92	0.00	1.92	1.02	41
8	20 - 22	21	-21	37	49	120	2.52	0.00	2.52	0.92	46
9	25 - 27	26	-26	26	35	121	3.13	0.00	3.13	0.85	30



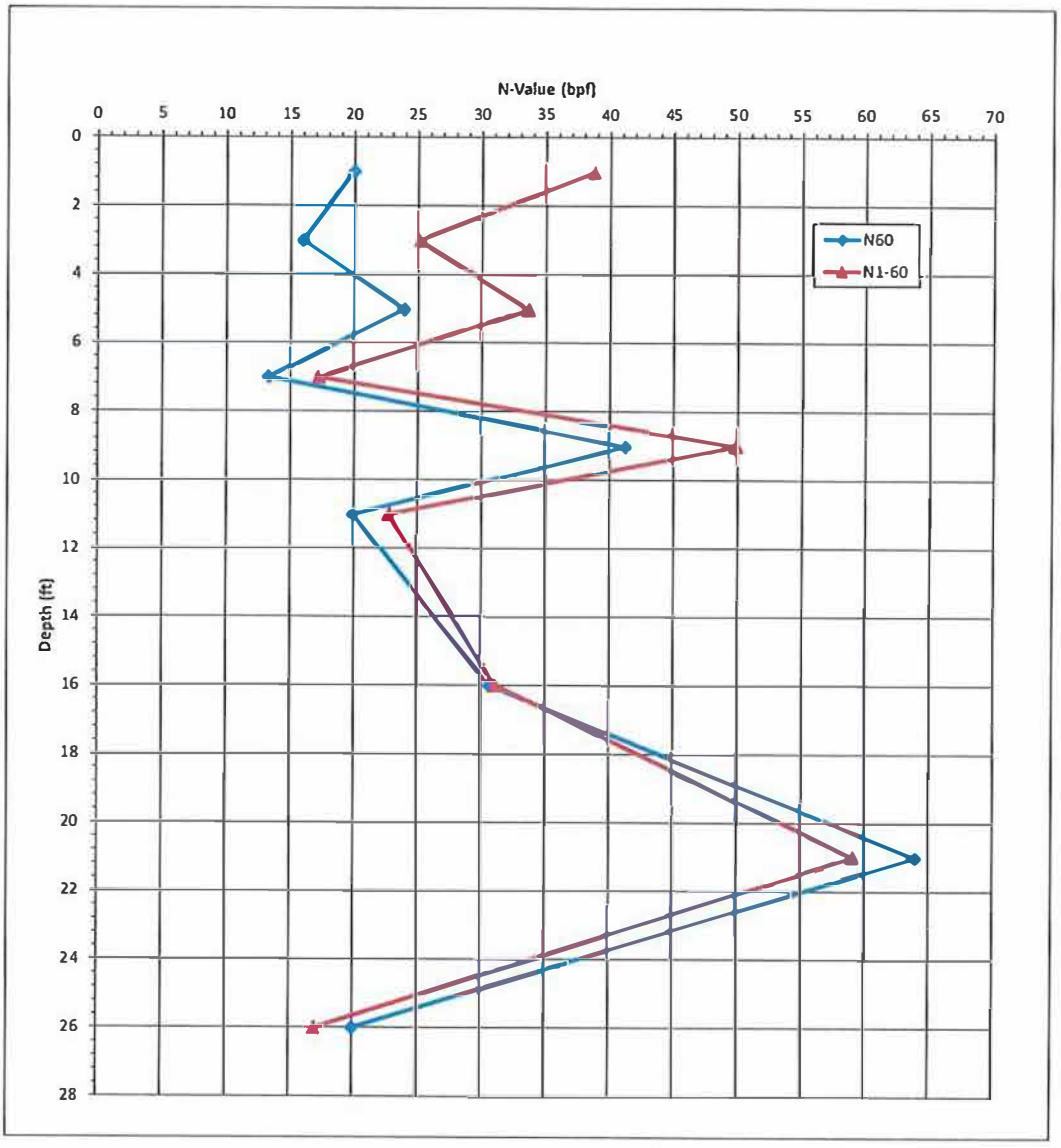
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	B-7
Elevation, ft	0
Groundwater Depth, ft	None
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6) σ' = σt - u CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf N160 = N60*CN

Sample Number	Sample Depth	N-value Recorded			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	15	20	120	0.12	0.00	0.12	1.94	39
2	2 - 4	3	-3	12	16	120	0.36	0.00	0.36	1.58	25
3	4 - 6	5	-5	18	24	120	0.60	0.00	0.60	1.40	34
4	6 - 8	7	-7	10	13	120	0.84	0.00	0.84	1.29	17
5	8 - 10	9	-9	31	41	120	1.08	0.00	1.08	1.21	50
6	10 - 12	11	-11	15	20	120	1.32	0.00	1.32	1.14	23
7	15 - 17	16	-16	23	31	120	1.92	0.00	1.92	1.02	31
8	20 - 22	21	-21	48	64	120	2.52	0.00	2.52	0.92	59
9	25 - 27	26	-26	15	20	121	3.13	0.00	3.13	0.85	17



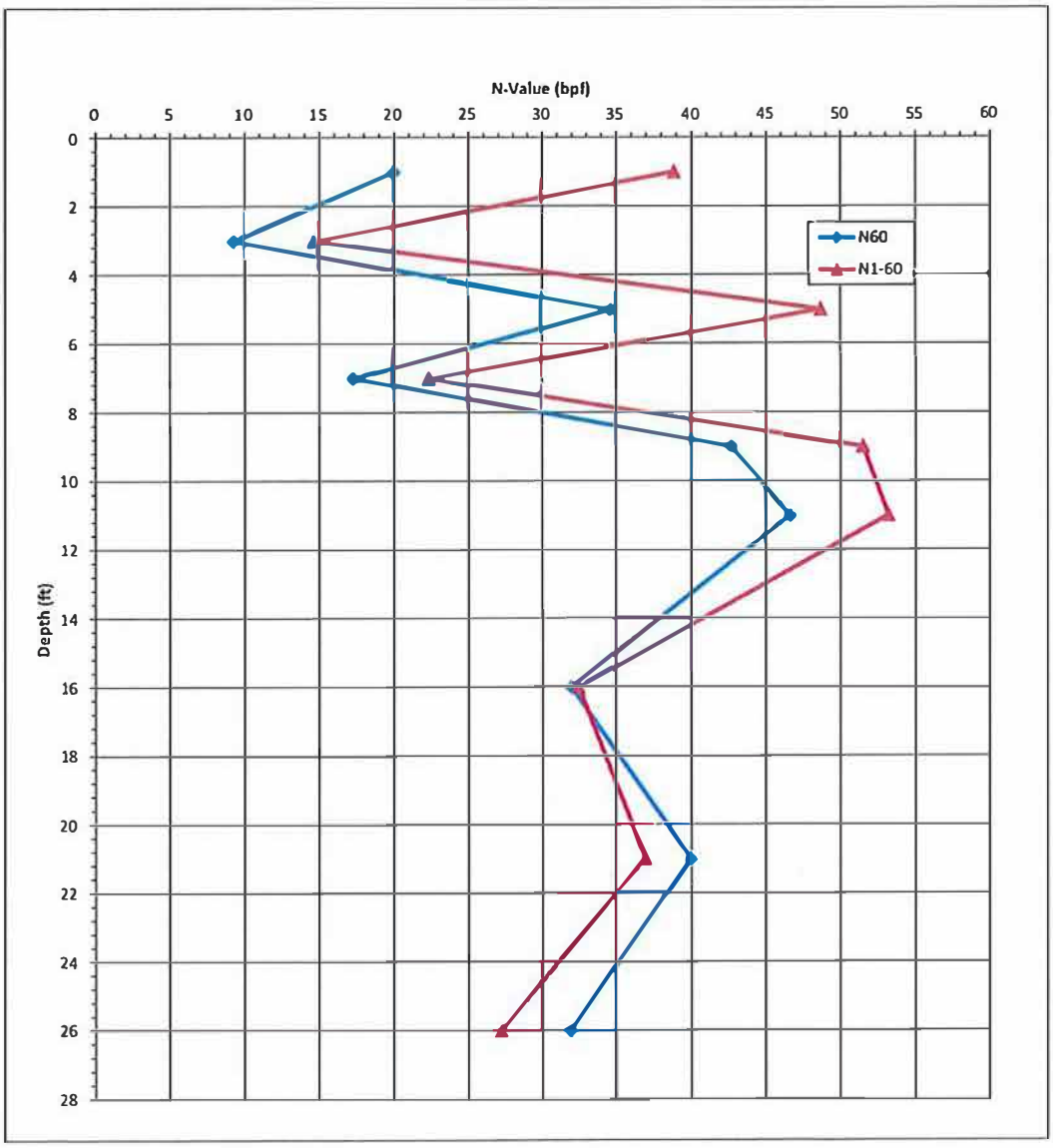
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	8-8
Elevation, ft	0
Groundwater Depth, ft	None
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6) σ' = σt - u CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf N160 = N60*CN

Sample Number	Sample Depth	N-value Recorded			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	15	20	120	0.12	0.00	0.12	1.94	39
2	2 - 4	3	-3	7	9	120	0.36	0.00	0.36	1.58	15
3	4 - 6	5	-5	26	35	120	0.60	0.00	0.60	1.40	49
4	6 - 8	7	-7	13	17	120	0.84	0.00	0.84	1.29	22
5	8 - 10	9	-9	32	43	120	1.08	0.00	1.08	1.21	52
6	10 - 12	11	-11	35	47	120	1.32	0.00	1.32	1.14	53
7	15 - 17	16	-16	24	32	120	1.92	0.00	1.92	1.02	32
8	20 - 22	21	-21	30	40	120	2.52	0.00	2.52	0.92	37
9	25 - 27	26	-26	24	32	121	3.13	0.00	3.13	0.85	27



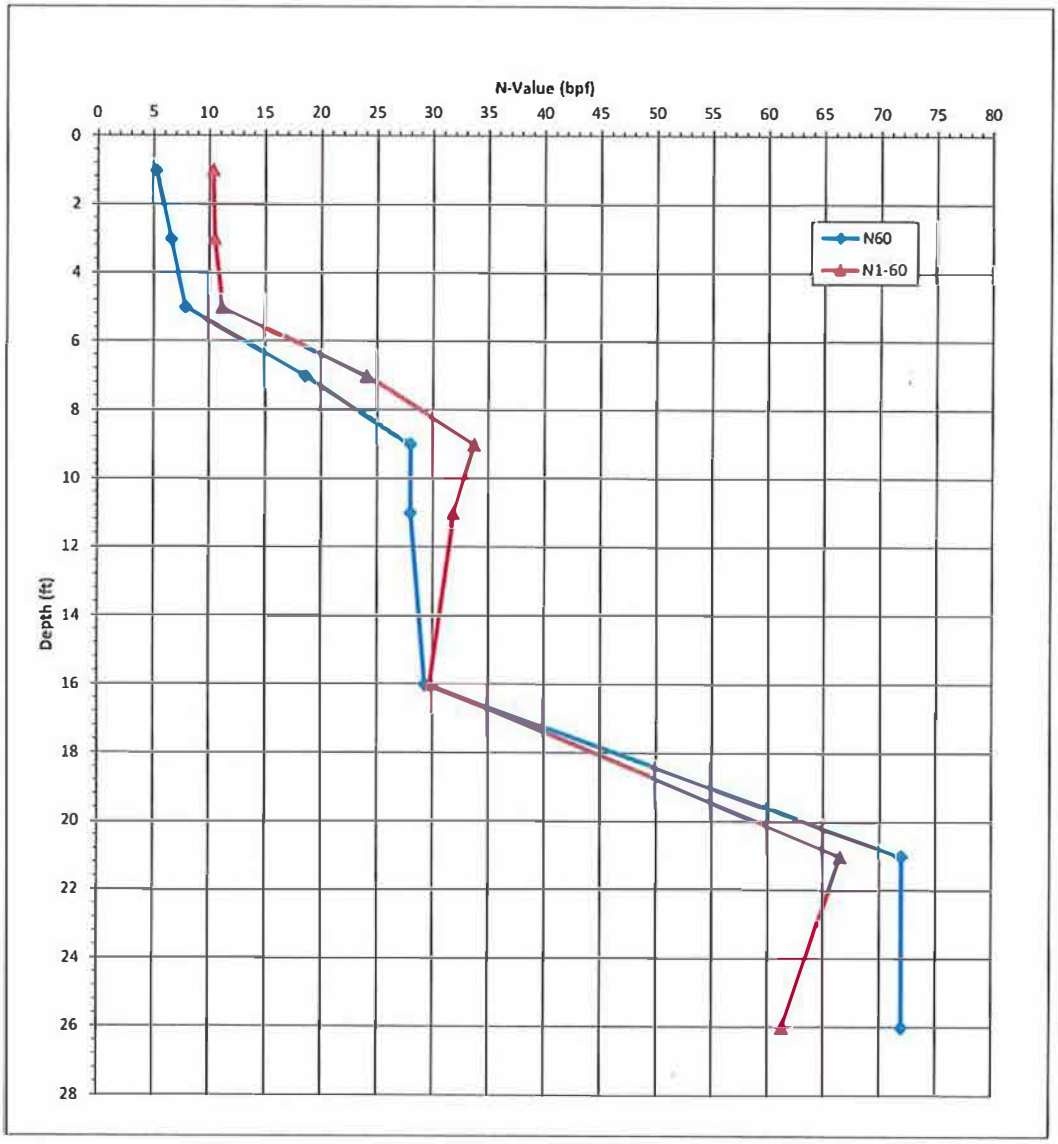
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	B-9
Elevation, ft	0
Groundwater Depth, ft	None
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)
	σ' = σt - u
	CN = .77log(40/σ') CN < 2 Only valid for σ' ≥ 0.5 ksf
	N160 = N60*CN

Sample Number	Sample Depth	N-value Recorded			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	4	5	120	0.12	0.00	0.12	1.94	10
2	2 - 4	3	-3	5	7	120	0.36	0.00	0.36	1.58	11
3	4 - 6	5	-5	6	8	120	0.60	0.00	0.60	1.40	11
4	6 - 8	7	-7	14	19	120	0.84	0.00	0.84	1.29	24
5	8 - 10	9	-9	21	28	120	1.08	0.00	1.08	1.21	34
6	10 - 12	11	-11	21	28	120	1.32	0.00	1.32	1.14	32
7	15 -17	16	-16	22	29	120	1.92	0.00	1.92	1.02	30
8	20 - 22	21	-21	54	72	120	2.52	0.00	2.52	0.92	67
9	25 - 27	26	-26	54	72	121	3.13	0.00	3.13	0.85	61



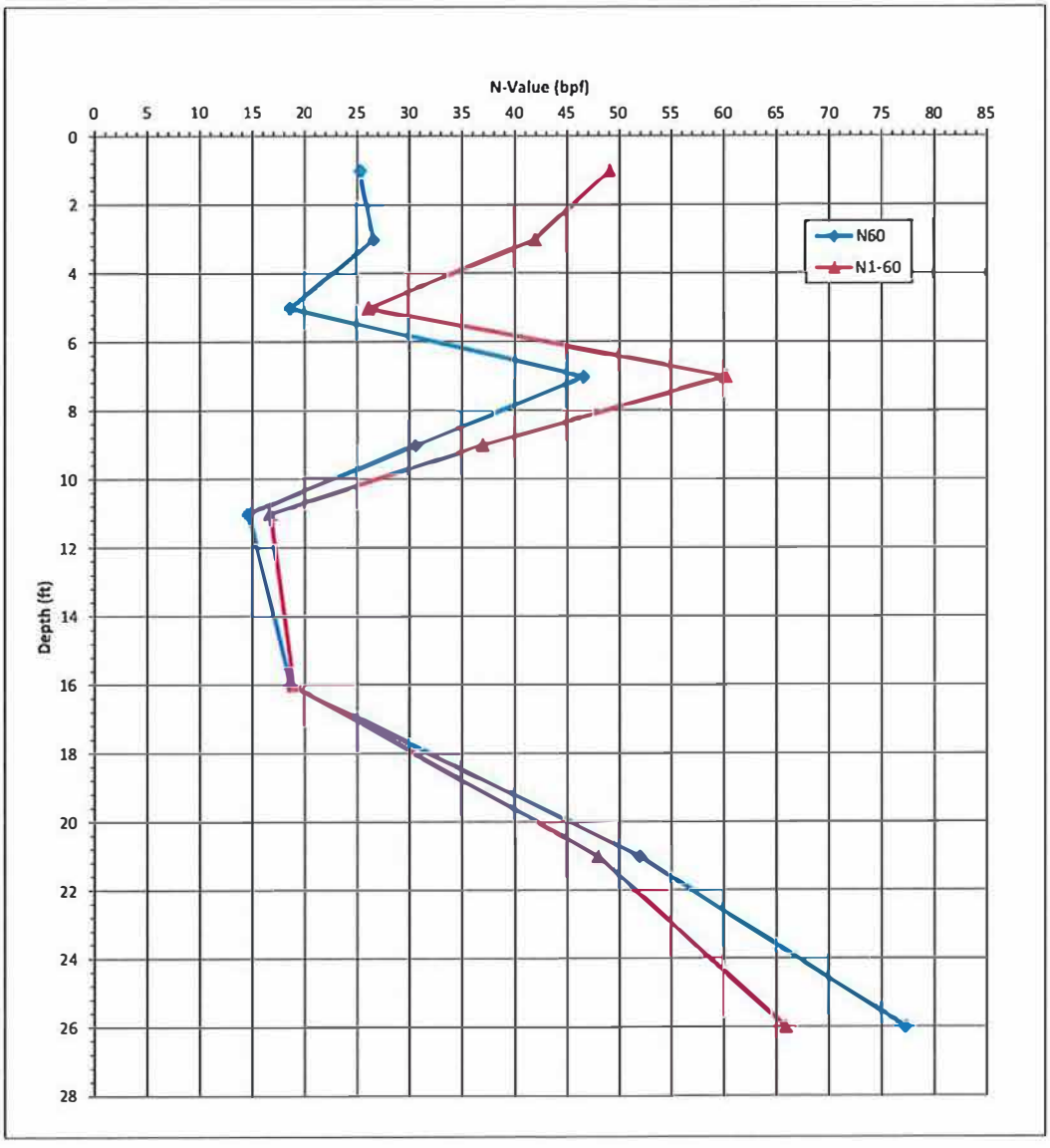
NORMALIZED & CORRECTED N VALUES

UCNJ Gymnasium Addition - Cranford Campus
Cranford, NJ

Boring No.	B-10
Elevation, ft	0
Groundwater Depth, ft	None
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	$N60 = N(E/.6)$
	$\sigma' = \sigma t - u$
	$CN = .77\log(40/\sigma')$ $\quad CN < 2$ $\quad$ Only valid for $\sigma' \geq 0.5$ ksf
	$N160 = N60 * CN$

Sample Number	Sample Depth	N-value Recorded			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	19	25	120	0.12	0.00	0.12	1.94	49
2	2 - 4	3	-3	20	27	120	0.36	0.00	0.36	1.58	42
3	4 - 6	5	-5	14	19	120	0.60	0.00	0.60	1.40	26
4	6 - 8	7	-7	35	47	120	0.84	0.00	0.84	1.29	60
5	8 - 10	9	-9	23	31	120	1.08	0.00	1.08	1.21	37
6	10 - 12	11	-11	11	15	120	1.32	0.00	1.32	1.14	17
7	15 - 17	16	-16	14	19	120	1.92	0.00	1.92	1.02	19
8	20 - 22	21	-21	39	52	120	2.52	0.00	2.52	0.92	48
9	25 - 27	26	-26	58	77	121	3.13	0.00	3.13	0.85	66



Appendix E

Lab Results

SUMMARY OF LABORATORY TEST DATA

Project Name: UCNJ Gymnasium Addition
RVE #4030X002
Client Name: Remington & Vernick Engineers
TRC Project #: 659933

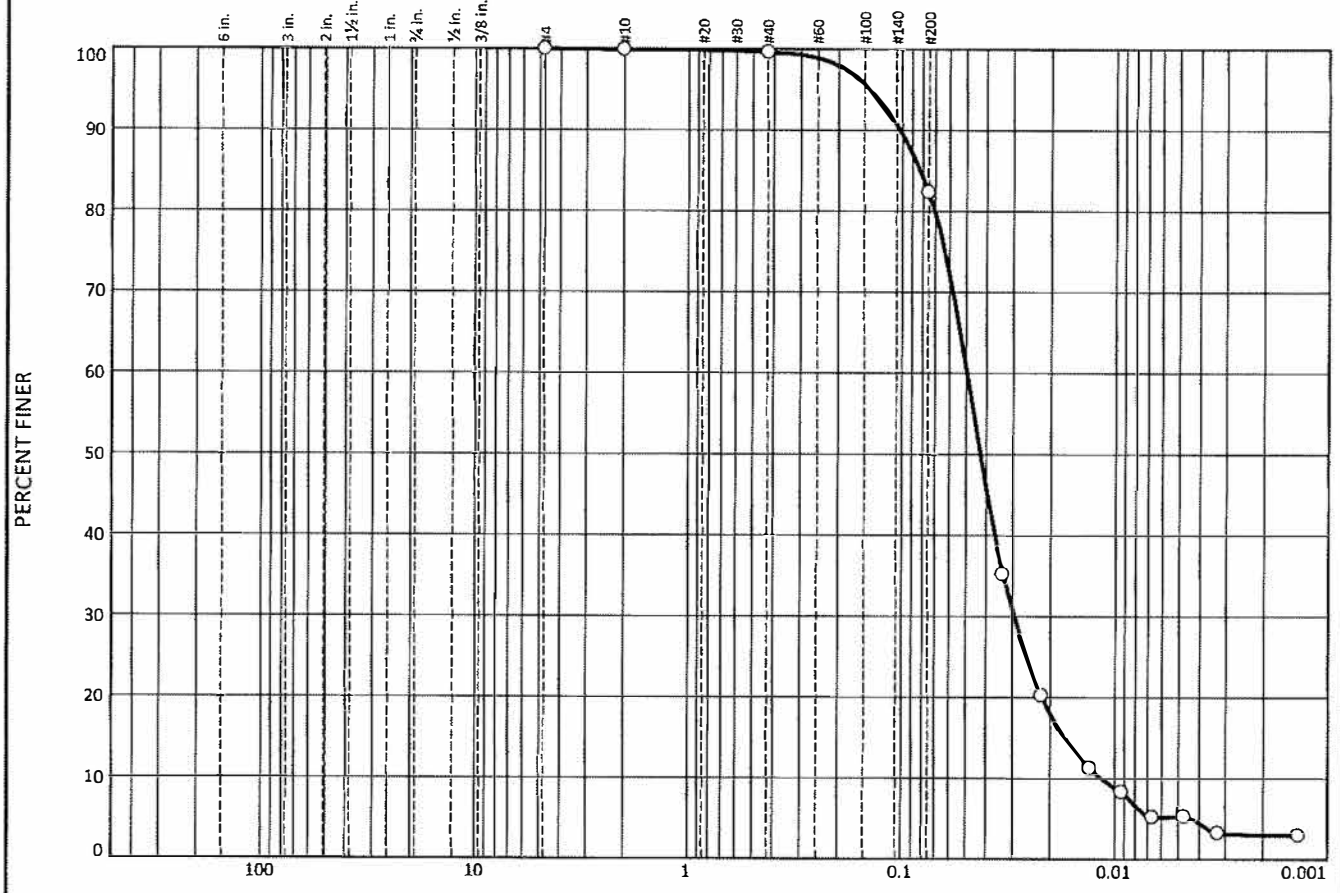
SAMPLE IDENTIFICATION			Soil Group (USCS System)*	Moisture Content (%)	GRAIN SIZE DISTRIBUTION USCS GRADATION			
Source #	Sample #	Depth (ft)			Gravel (%)	Sand (%)	Silt (%)	Clay (%)
B-1	S-3	4.0-6.0	ML	13.6	0.0	17.7	77.0	5.3
B-2	S-4	6.0-8.0	ML	18.9	0.3	6.6	77.9	15.2
B-4	S-4	6.0-8.0	ML	17.9	1.6	10.2	73.1	15.1
B-5	S-4	6.0-8.0	ML	12.7	10.0	37.5	41.5	11.0
B-7	S-4	6.0-8.0	SM	11.3	17.8	38.5	31.6	12.6
B-9	S-3	4.0-6.0	SM	14.4	0.7	50.2	36.0	13.1
B-9	S-7	15.0-17.0	SC-SM	11.4	23.5	41.9	23.6	11.0
B-10	S-3	4.0-6.0	ML	13.4	7.0	38.9	40.3	13.8

**USCS based on grain-size distribution and visual classification. An Atterberg limits test was not requested.*

DRAWN BY: TBT 03/13/25

CHECKED BY: JPB 03/13/25

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.3	17.3	77.0	5.3

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0825	0.0494	0.0426	0.0294	0.0171	0.0116	1.51	4.27

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ RED-BROWN SILT WITH SAND	03/13/25	ML	13.6

Project No. 659933 **Client:** REMINGTON & VERNICK ENGINEERS

Project: UCNJ GYMNASIUM ADDITION

RVE #4030X002

○ **Source of Sample:** B-1 **Depth:** 4.0-6.0 FT **Sample Number:** S-3

TRC Engineers, Inc.

Mt. Laurel, NJ

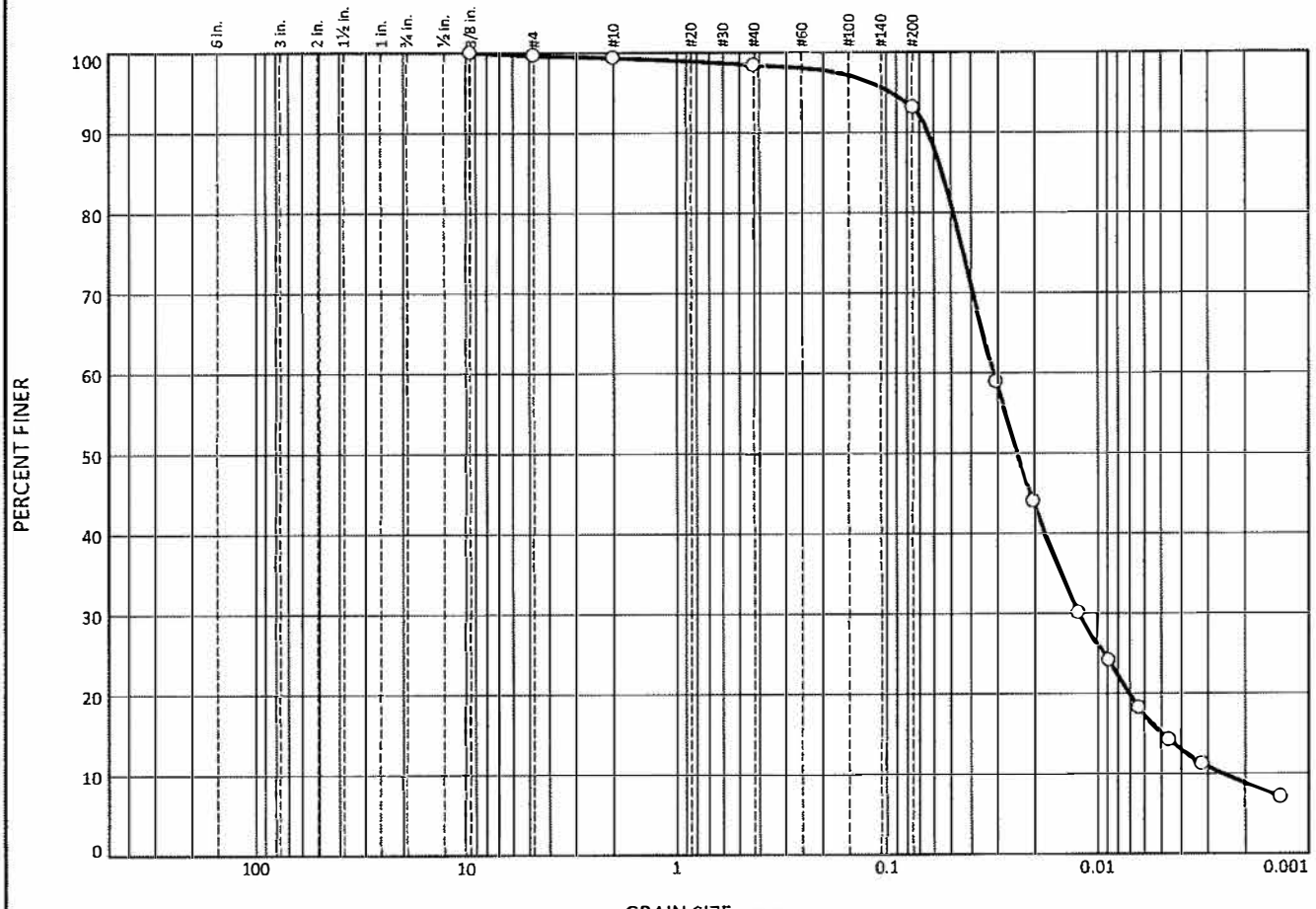
Remarks:

○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION

Figure 1

Tested By: JP 03/13/25 **Checked By:** JPB 03/13/25

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.3	0.4	0.9	5.3	77.9	15.2

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0547	0.0313	0.0241	0.0122	0.0049	0.0026	1.87	12.21

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ RED-BROWN SILT	03/13/25	ML	18.9

Project No. 659933 **Client:** REMINGTON & VERNICK ENGINEERS

Project: UCNJ GYMNASIUM ADDITION

RVE #4030X002

○ **Source of Sample:** B-2 **Depth:** 6.0-8.0 FT **Sample Number:** S-4

TRC Engineers, Inc.

Mt. Laurel, NJ

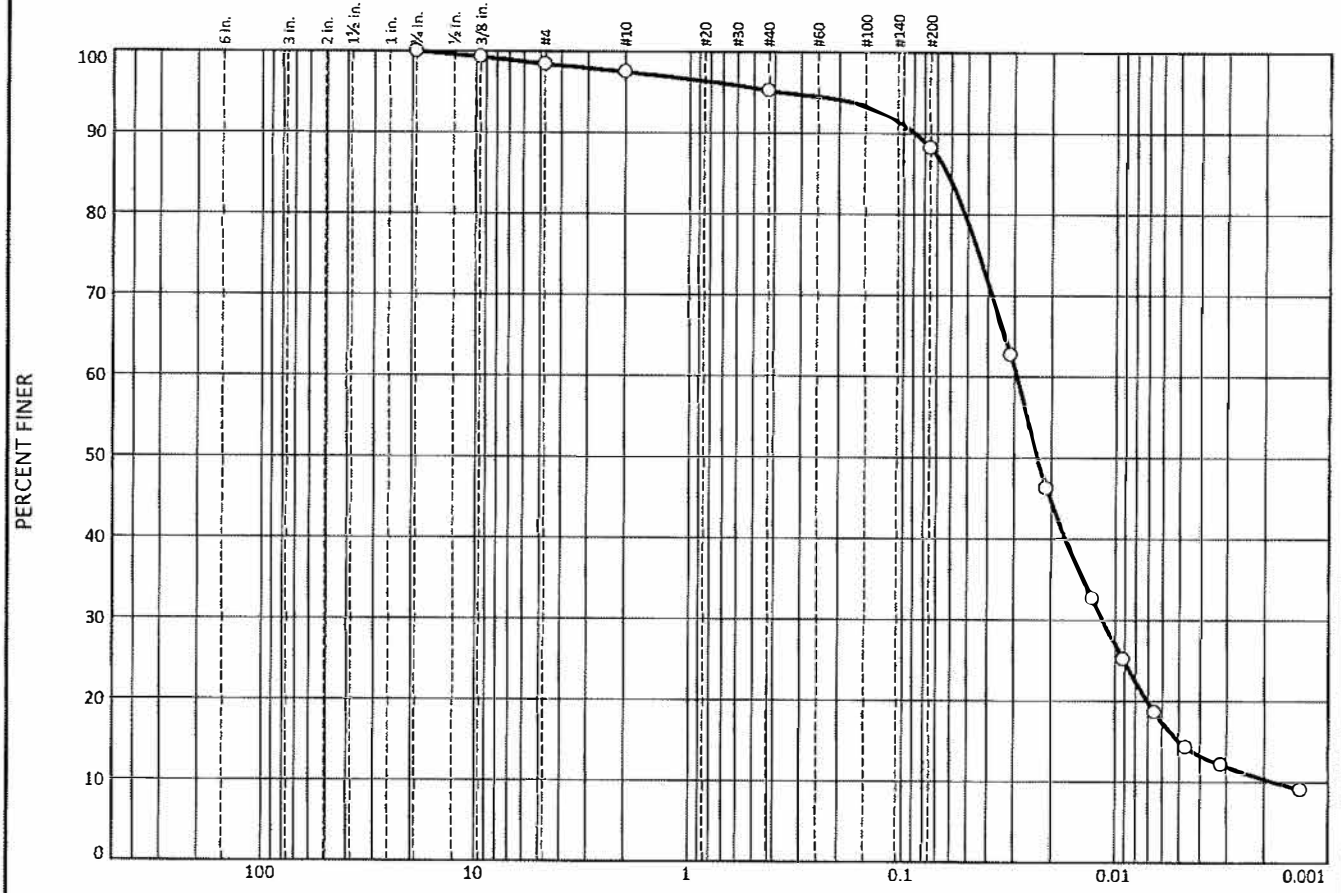
Remarks:

○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION

Figure 2

Tested By: JP 03/13/25 **Checked By:** JPB 03/13/25

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.6	0.9	2.3	7.0	73.1	15.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0623	0.0291	0.0232	0.0114	0.0050	0.0018	2.48	16.22

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ RED-BROWN SILT	03/12/25	ML	17.9

Project No. 659933 **Client:** REMINGTON & VERNICK ENGINEERS

Project: UCNJ GYMNASIUM ADDITION

RVE #4030X002

○ **Source of Sample:** B-4 **Depth:** 6.0-8.0 FT **Sample Number:** S-4

Remarks:

○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION

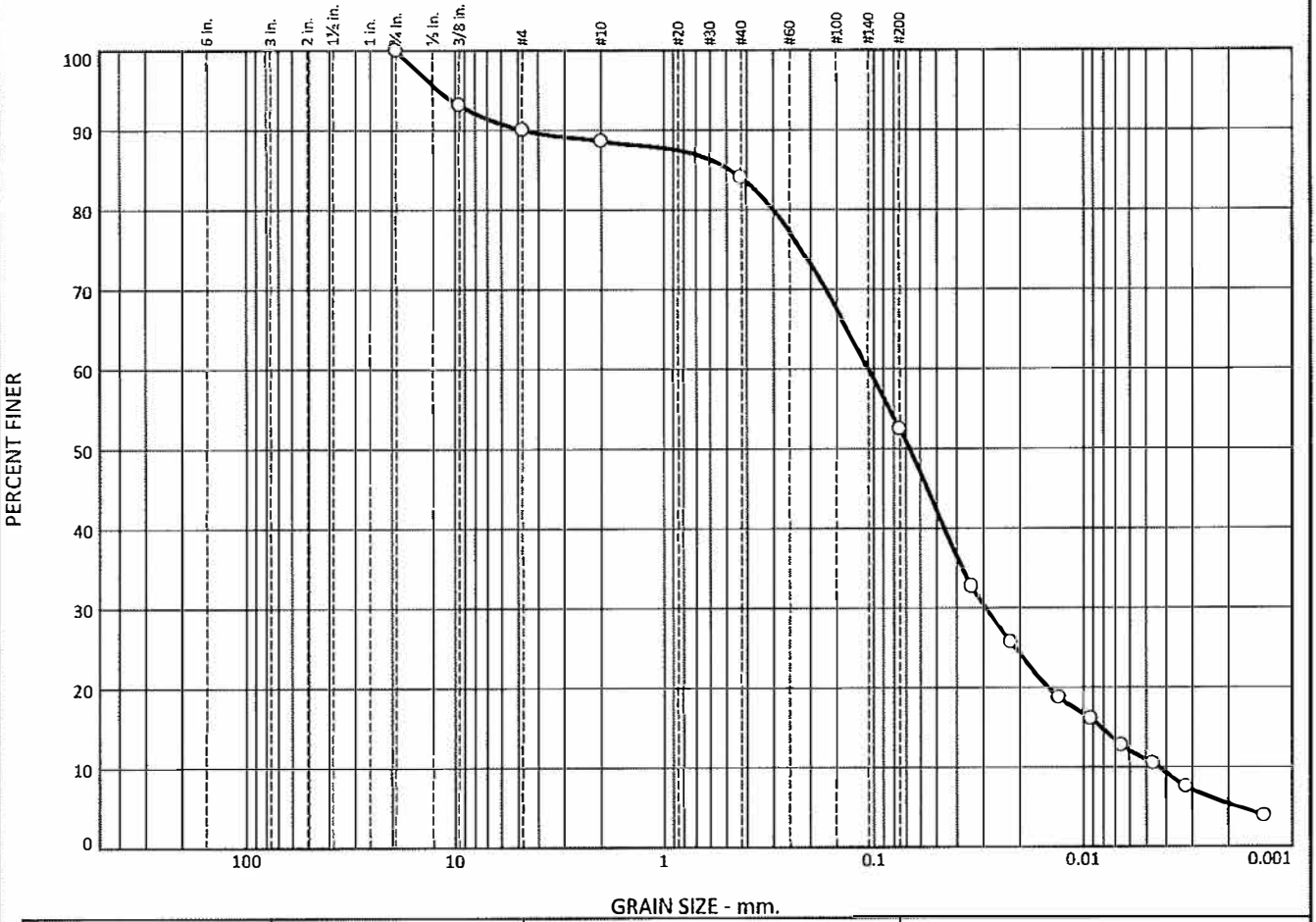
TRC Engineers, Inc.

Mt. Laurel, NJ

Figure 3

Tested By: JP 03/12/25 **Checked By:** JPB 03/13/25

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	10.0	1.4	4.6	31.5	41.5	11.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4804	0.1058	0.0673	0.0293	0.0082	0.0044	1.86	24.30

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ RED-BROWN SANDY SILT	03/12/25	ML	12.7

Project No. 659933 **Client:** REMINGTON & VERNICK ENGINEERS

Project: UCNJ GYMNASIUM ADDITION

RVE #4030X002

○ **Source of Sample:** B-5 **Depth:** 6.0-8.0 FT **Sample Number:** S-4

TRC Engineers, Inc.

Mt. Laurel, NJ

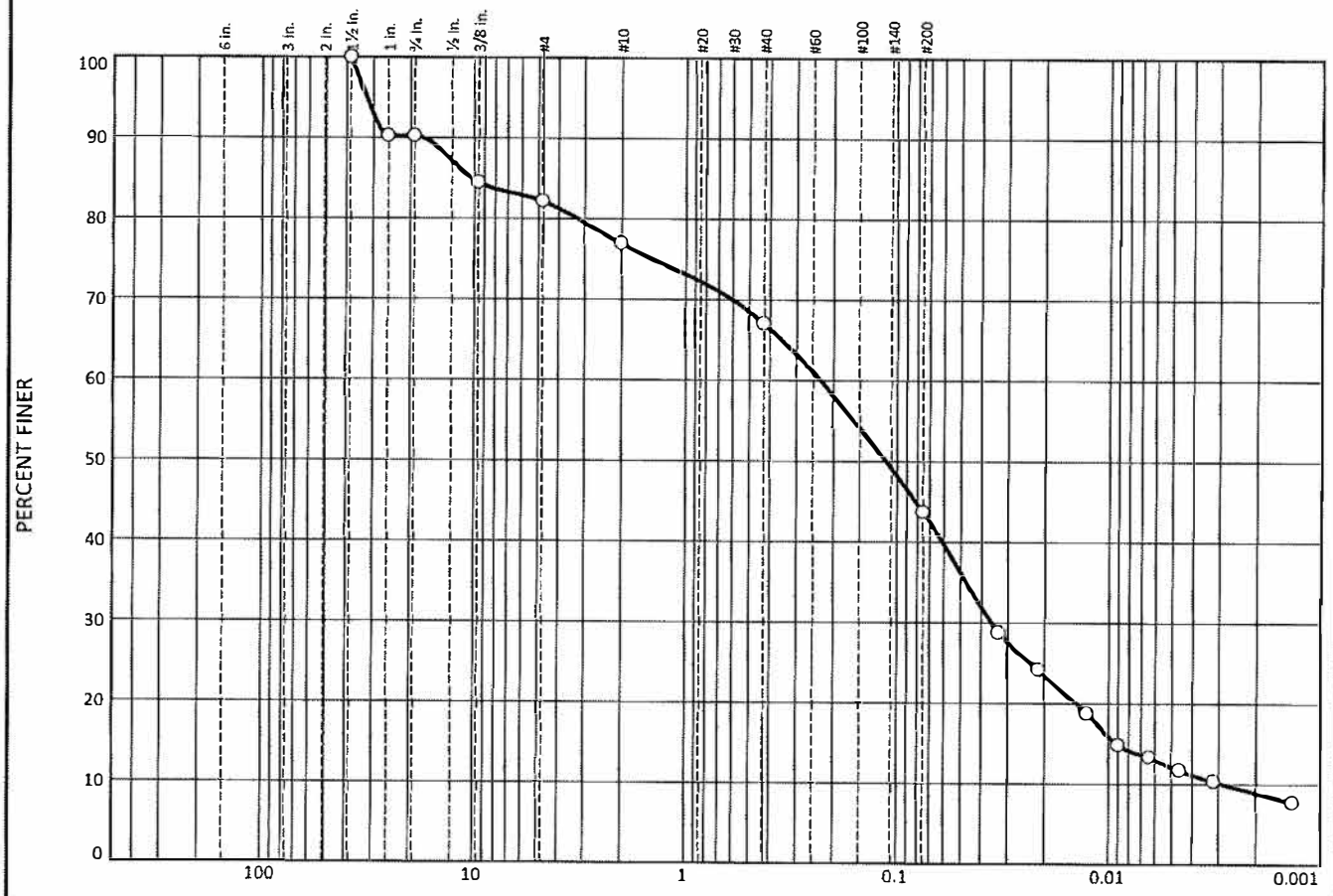
Remarks:

○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION

Figure 4

Tested By: JP 03/12/25 **Checked By:** JPB 03/13/25

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	9.8	8.0	5.3	9.9	23.3	31.6	12.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			10.2830	0.2301	0.1129	0.0357	0.0092	0.0029	1.92	79.81

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ RED/DARK BROWN SILTY SAND WITH GRAVEL	03/13/25	SM	11.3

Project No. 659933 **Client:** REMINGTON & VERNICK ENGINEERS

Project: UCNJ GYMNASIUM ADDITION

RVE #4030X002

○ **Source of Sample:** B-7 **Depth:** 6.0-8.0 FT **Sample Number:** S-4

Remarks:

○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION

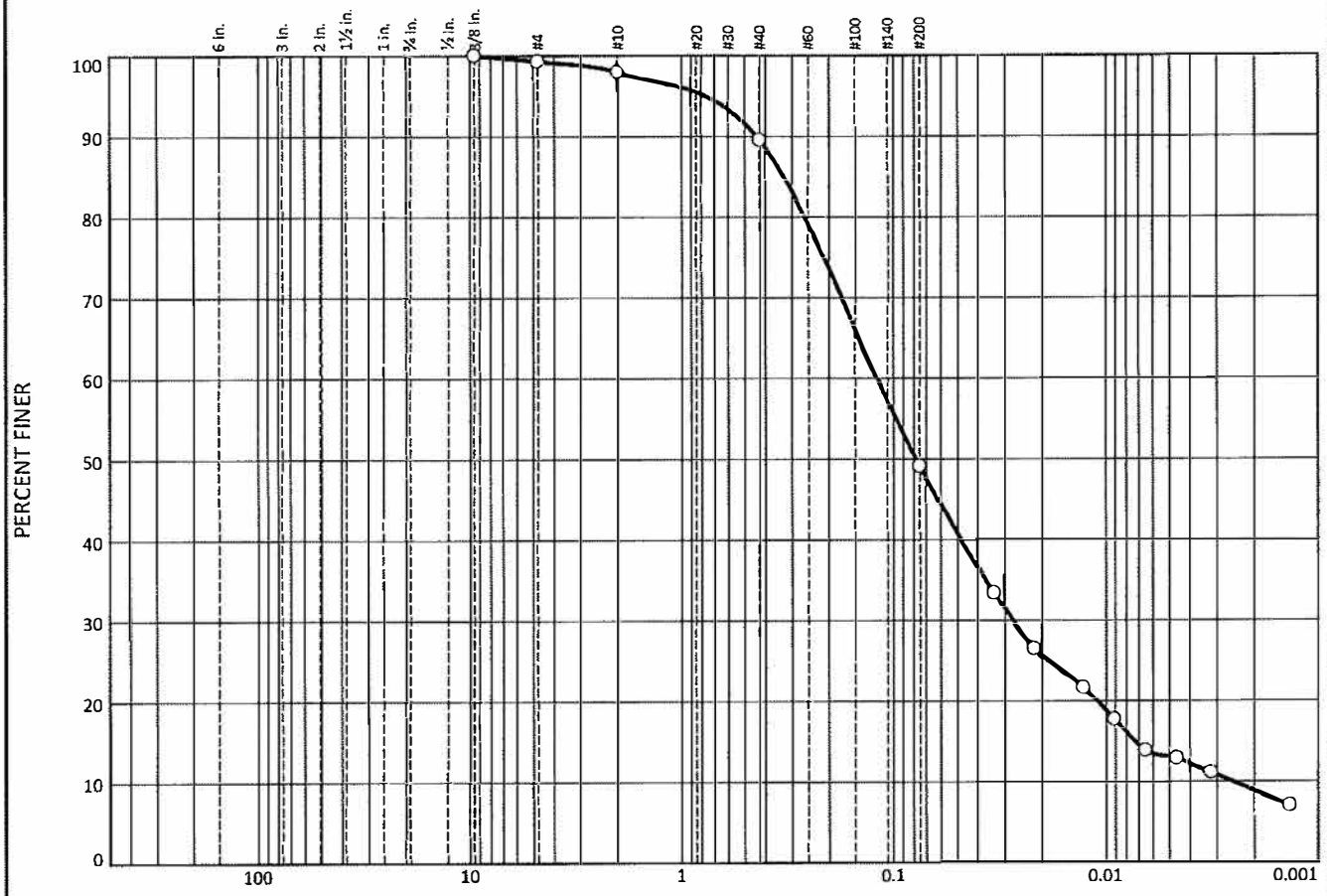
TRC Engineers, Inc.

Mt. Laurel, NJ

Figure 5

Tested By: OA 03/13/25 **Checked By:** JPB 03/13/25

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.7	1.3	8.5	40.4	36.0	13.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.3269	0.1183	0.0783	0.0274	0.0073	0.0025	2.50	46.69

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ RED-BROWN SILTY SAND	03/13/12	SM	14.4

Project No. 659933 **Client:** REMINGTON & VERNICK ENGINEERS

Project: UCNJ GYMNASIUM ADDITION

RVE #4030X002

○ **Source of Sample:** B-9 **Depth:** 4.0-6.0 FT **Sample Number:** S-3

TRC Engineers, Inc.

Mt. Laurel, NJ

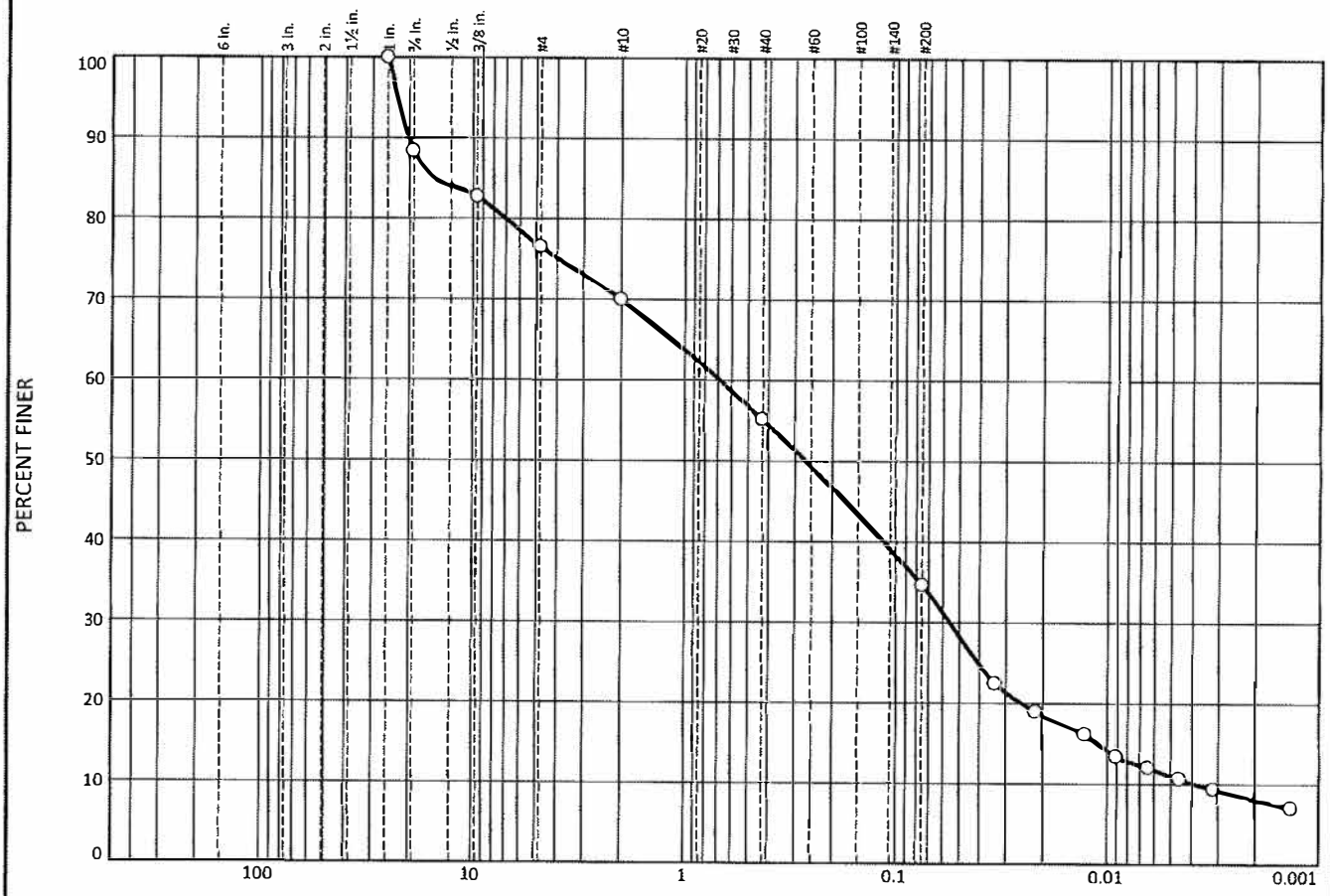
Remarks:

○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION

Figure 6

Tested By: JP 03/13/25 **Checked By:** JPB 03/13/25

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	11.7	11.8	6.5	14.9	20.5	23.6	11.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			15.2447	0.6794	0.2655	0.0555	0.0109	0.0039	1.17	175.94

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ RED-BROWN/GRAY SILTY, CLAYEY SAND WITH GRAVEL	03/13/25	SC-SM	11.4

Project No. 659933 **Client:** REMINGTON & VERNICK ENGINEERS

Project: UCNJ GYMNASIUM ADDITION

RVE #4030X002

○ **Source of Sample:** B-9 **Depth:** 15.0-17.0 FT **Sample Number:** S-7

TRC Engineers, Inc.

Mt. Laurel, NJ

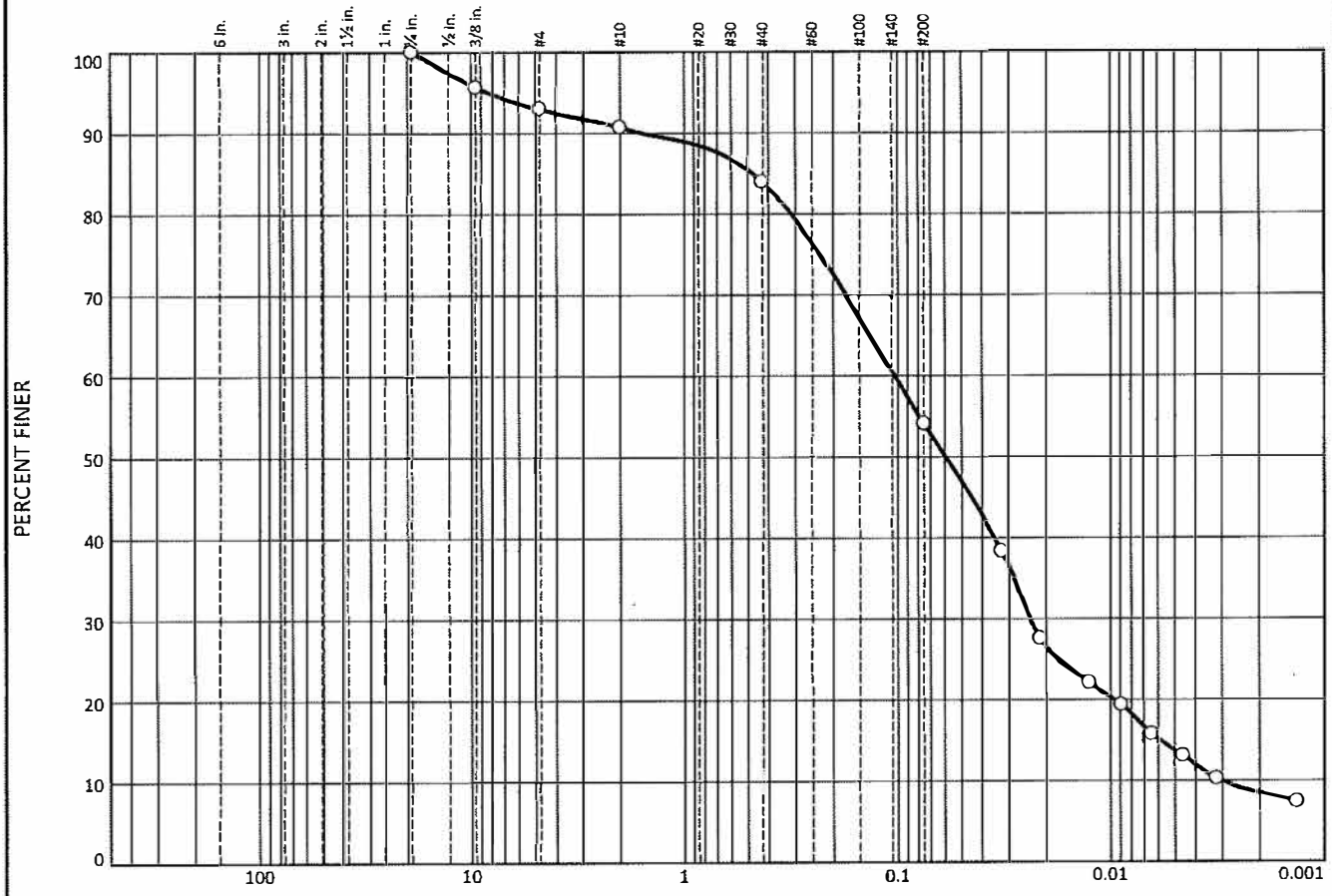
Remarks:

○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION

Figure 7

Tested By: OA 03/13/25 **Checked By:** JPB 03/13/25

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	7.0	2.3	6.8	29.8	40.3	13.8

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4738	0.1031	0.0594	0.0237	0.0059	0.0030	1.80	34.07

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ RED-LIGHT BROWN SANDY SILT	03/13/25	ML	13.4

Project No. 659933 **Client:** REMINGTON & VERNICK ENGINEERS

Project: UCNJ GYMNASIUM ADDITION

RVE #4030X002

○ **Source of Sample:** B-10 **Depth:** 4.0-6.0 FT **Sample Number:** S-3

Remarks:

○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION

TRC Engineers, Inc.

Mt. Laurel, NJ

Figure 8

Tested By: JP 03/13/25 **Checked By:** JPB 03/13/25

Appendix F

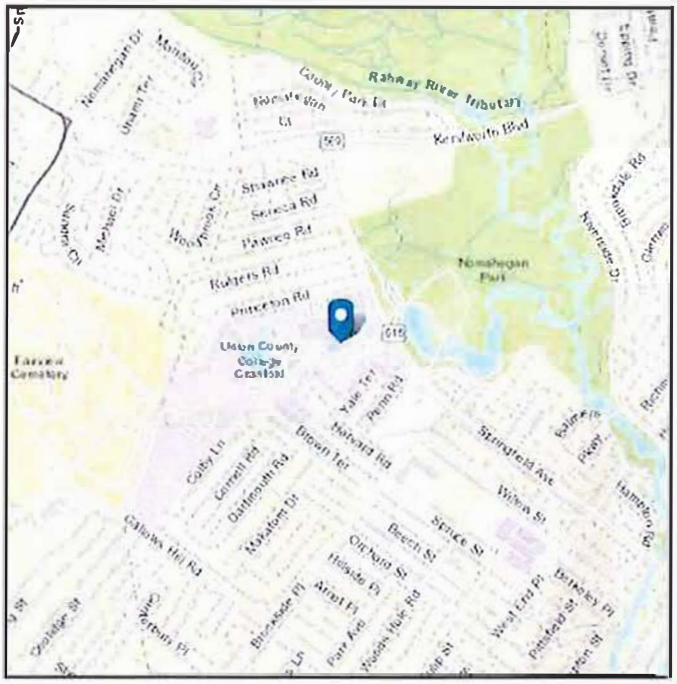
Seismic Information

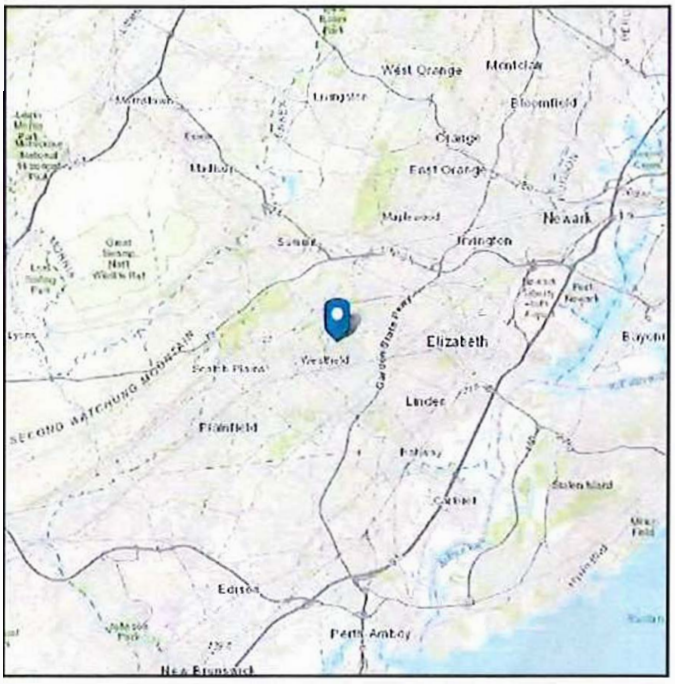
ASCE Hazards Report

Address:
1033 Springfield Ave
Cranford, New Jersey
07016

Standard: ASCE/SEI 7-16
Risk Category: III
Soil Class: D - Stiff Soil

Latitude: 40.667327
Longitude: -74.319744
Elevation: 82.67717050328092 ft (NAVD 88)





ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

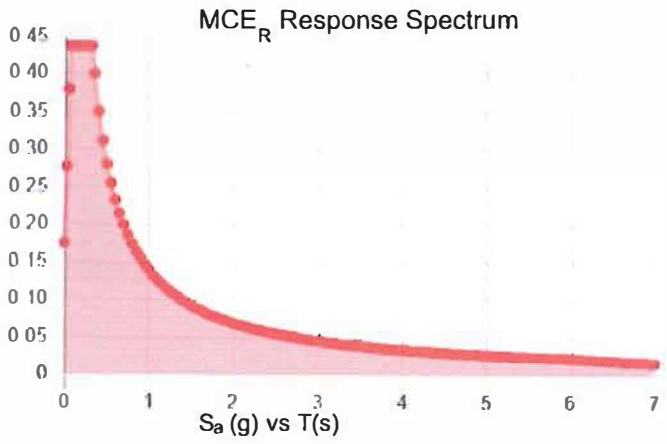
Seismic

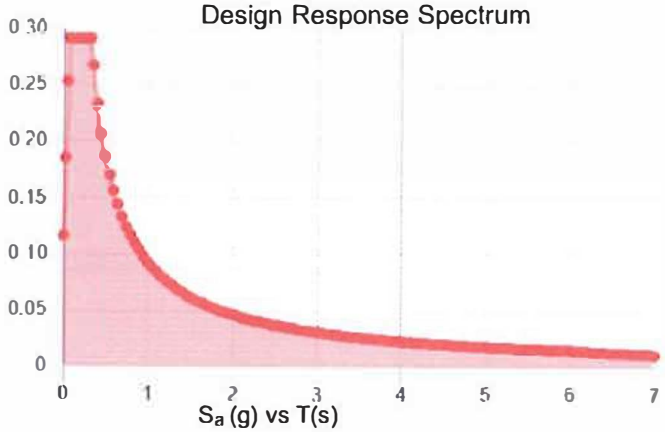
Site Soil Class: D - Stiff Soil

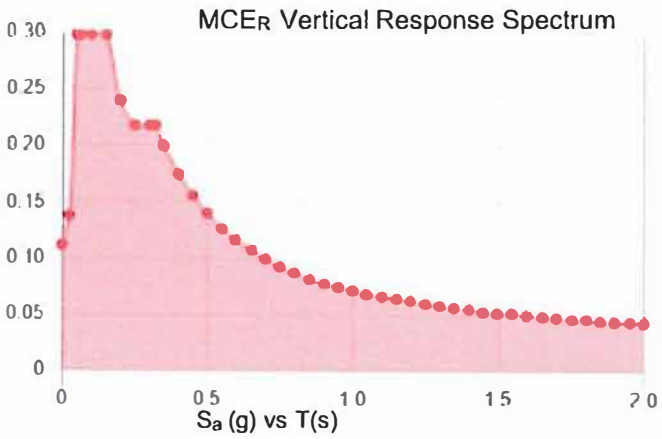
Results:

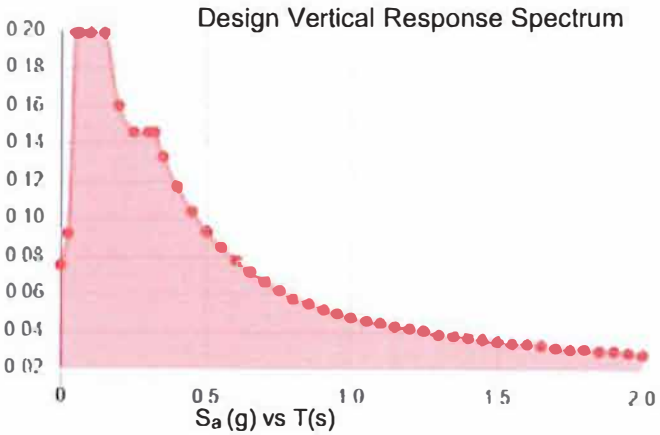
S_S :	0.277	S_{D1} :	0.093
S_1 :	0.058	T_L :	6
F_a :	1.579	PGA :	0.169
F_v :	2.4	PGA_M :	0.247
S_{MS} :	0.437	F_{PGA} :	1.462
S_{M1} :	0.14	I_e :	1.25
S_{DS} :	0.291	C_v :	0.853

Seismic Design Category: B









Data Accessed: Wed Mar 19 2025

Date Source:
USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

The ASCE Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

ASCE does not intend, nor should anyone interpret, the results provided by this Tool to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this Tool or the ASCE standard.

In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE Hazard Tool.

4030X002 - UCNJ Gymnasium Addition Geotech Report 2025-04-02 rev00

Final Audit Report 2025-04-14

Created:	2025-04-14
By:	K. Charles Westen (charles.westen@rve.com)
Status:	Signed
Transaction ID:	CBJCHBCAABAAuX1pXKFGFIgBXiNx9zfFoUPk0aZ2c4Xn

"4030X002 - UCNJ Gymnasium Addition Geotech Report 2025-04-02 rev00" History

Document created by K. Charles Westen (charles.westen@rve.com)
2025-04-14 - 2:44:50 PM GMT

Document e-signed by K. Charles Westen (charles.westen@rve.com)
Signature Date: 2025-04-14 - 2:45:47 PM GMT - Time Source: server

Agreement completed.
2025-04-14 - 2:45:47 PM GMT

Adobe Acrobat Sign

APPENDIX E

EMERGENCY RESPONDER COMMUNICATIONSENHANCEMENT SYSTEM REQUIREMENTS FOR CRANFORD, NEW JERSEY

EMERGENCY RESPONDER COMMUNICATIONS ENHANCEMENT SYSTEM (ERCES) REQUIREMENTS FOR CRANFORD, NEW JERSEY

Introduction

Provided herein are the requirements associated with ERCES in the Township of Cranford NJ. An ERCES is a wireless system that provides signal enhancement for first responder portable radios operating inside a building. These systems are required in newly constructed buildings in the event the radio transmission towers used by Cranford first responders do not provide adequate radio coverage throughout the building.

Preliminary Survey

A survey must be performed at the property prior to occupancy to determine if portable radio coverage meets performance metrics, as defined by NJAC 5:23-3.14, 2021 IBC/NJ 918 and 2021 IFC 510. The technical requirements for the survey are that the system performance must provide a minimum RF signal level of -95 dBm and a delivered audio quality (DAQ) of 3.0 in 95% of the general areas and 99% of the critical areas (see below - ERCES Integrator Responsibilities for additional information). If the performance metrics are met, an ERCES, typically, will not be required.

The survey should be performed after a significant amount of construction has been completed. Ideally, the interior walls, external façade, doors and windows should all be installed. The survey may need to be performed sooner if the ceiling and vertical pathways are scheduled for installation prior to the completion of the work referenced above. In the event the survey is inconclusive (i.e. building passes with a nominal margin but significant construction remains), ERCES infrastructure should be installed in areas prior to when cable pathways will be rendered inaccessible. System electronics can be purchased and installed, if after the majority of the construction is completed, retesting the building indicates that a system is needed.

A report shall be issued and submitted to the authority having jurisdiction (AHJ), and other interested parties, providing the results and recommendations, as determined by the survey.

ERCES - General

In the event the signal performance metrics are not met, as determined by the preliminary survey, an ERCES will be required. The processes and requirements for the ERCES are provided below. These specifications are a guide for integrators to use and understand for inspections, plan reviews, and system deployments.

All integrators must be knowledgeable of the industry standards and codes enforced by the township of Cranford. A general radio operators license (GROL), as issued by the Federal Communications Commission (FCC), is required by the project lead.

As for the distribution date of this document, the adopted code governing ERCES in the state of New Jersey consists of the following references:

- NJAC 5:23-3.14 (adopted September 2022)
- 2021 IBC/NJ 918

- 2021 IFC 510
- 2019 NFPA-1221
- 2020 NFPA-70

System Description

Cranford first responders (i.e. Fire, EMS and Police), utilize the New Jersey Interoperability Communications System (NJICS) to support their 2-way radio communications requirements. NJICS radio transmission sites located in Union County operate in the 700 MHz and 800 MHz frequency band. The frequencies of operation are shown below in table 1.

The ERCES consists of a roof mounted antenna, bi-directional amplifier (BDA), and RF infrastructure (i.e., cable, splitters, and antennas). The electronics (i.e BDA and battery plant) must be listed, UL2524 and FCC Part 90 compliant. Electronics are housed in a NEMA 4 rated enclosure per requirements of NFPA 1221 and IFC 510 and must be in a 2-hour rated room, or a rated enclosure.

The signals from the NJICS transmission tower are received by the external antenna on the roof of the property. The signals are delivered to the system's BDA, via coaxial cable, where it is amplified. The amplified BDA output signals are connected to the RF infrastructure (i.e. cables, splitters, and antennas), which provides in-building wireless coverage for mobile operators (i.e. PD, Fire and EMS) equipped with portable radios. The portable radio user's communication back to the transmission tower follows a reciprocal path that the tower originated signal traveled, facilitating a 2-way radio transmission path.

NJICS	
Transmit (MHz)	Receive (MHz)
774.6813	804.6813
773.4563	803.4563
772.7313	802.7313
771.4063	801.4063
771.0938	801.0938
770.2563	800.2563
854.7375	809.7375
853.6250	808.6250
853.3000	808.3000
852.5625	807.5625
851.2875	806.2875
856.6125	811.6125
857.6125	812.6125
851.2625	806.2625
858.1125	813.1125
772.2938	802.2938
773.6688	803.6688

Table 1.

Alarm and Monitoring System

The Emergency Responder Communication Enhancement System (ERCES) as described herein shall include electronic monitoring, configured as supervisory alarms, of the following system functions:

- Donor antenna malfunction
- Active RF-emitting device failure
- Low-battery capacity condition
- Power supply failure
- AC power failure
- System failure

A separate alarm for oscillating amplifiers is also required. The selected signal booster shall be capable of "AGC Overdrive" and "Oscillation Control" features. This includes, but is not limited to, an alarm and automatic shutdown for oscillating amplifiers. These features are intended to minimize interference due to oscillation of the BDA. Power supplies must, at a minimum, alarm at loss of AC power, failure of the battery charger, and low battery charge (70% of capacity).

External Antenna System

The external antenna is to be narrowband, high-gain, vertically polarized and designed for the specified frequency band of operation (700 MHz – 860 MHz). Yagi or corner reflector-type antennas are recommended. The installation of the donor antenna, including the outer conductor, of the coaxial cable, shall be suitably connected to the building electrical ground system.

If more than one donor antenna is to be installed in a single rooftop mast, then appropriate vertical and horizontal separation between antennas shall be considered. A weatherized coaxial lightning protector designed for the proper frequency band shall be installed in the coaxial feed of the donor antenna outside the facility.

Backbone Cabling

Backbone cable is a communications cable in an ERCES that carries signals to multiple floors such that the failure of that cable would eliminate coverage in a significant portion of the building. Consequently, cables designated as backbone cables must be 2-hour rated or be enclosed in a 2-hour rated pathway.

Backbone cable typically consists of the cable running from the roof mounted antenna, through the BDA, and to distribution antenna lines. [NFPA 1221 3.3.10].

Code requires a backbone cable to be routed through an enclosure that matches the building's fire rating [NFPA 9.6.2.3]. The connection between the backbone cables and the antenna cables shall be made within an enclosure that matches the building's fire rating. Passage of the antenna distribution cable in and out of the enclosure shall be fire-stopped. [NFPA 9.6.2.4]

The Township of Cranford requires that damage to a backbone cable, or backbone cable components, will not disable ERCES coverage through much or all the building. It is understood that the current code on this subject matter is somewhat subjective. A general benchmark to use for Cranford ERCES projects is that up to a maximum of 40% of the building will be allowed to have compromised coverage, should a

non-backbone (i.e. distribution antenna) cable fail. Each design drawing must clearly show backbone cable and clearly differentiate backbone cable from distribution antenna cable. The Township of Cranford will evaluate the utilization of backbone cable to determine if the design, in general, meets the 40% criteria, as referenced above.

ERCES Integrator Responsibilities

The integrator shall be responsible for the design, commissioning, and testing of the ERCES. The system performance must provide a minimum RF signal level of -95 dBm and a delivered audio quality (DAQ) of 3.0 in 95% of the general areas and 99% of the critical areas. See table 2 below for the description of DAQ values.

DAQ – Delivered Audio Quality

Category	Description
1	Unusable. Speech present but not understandable
2	Speech understandable with considerable effort. Requires frequent repetition due to noise or distortion
3	Speech understandable with slight effort. Requires occasional repetition due to noise or distortion
3.4	Speech understandable without repetition. Some noise or distortion present
4	Speech easily understandable. Little noise or distortion
4.5	Speech easily understandable. Rare noise or distortion
5	Perfect. No distortion or noise discernable.

Table 2.

Critical Areas, as referenced above, are defined as:

- Elevator shafts in all buildings six stories or greater
- Elevator lobbies
- Generator rooms
- Fire pump rooms
- Mechanical rooms
- Stair enclosures
- Fire command centers
- Any other area deemed critical by the AHJ

The ERCES shall be compatible with analog and digital communication systems simultaneously at the time of installation. Either the BDA or battery plant shall be powered via a “hard-wired”, dedicated 20 Amp circuit. A breaker “lock-out” will be required in the feeder panel.

A surge protection device shall be used to protect active components of the BDA from electrical transients. For Class A channelized BDA’s, the integrator must ensure in accordance with FCC Part 90 that Class A (narrowband) signal boosters do not cause interference to other licensed services. Upon completion of the installation, the system will be commissioned to validate that the ERCES meets all code criteria, as defined in 2021 IFC 510.

The integrator shall be responsible for all permits, as required by the Township.

In addition, the following documentation must be provided in the form of a close-out report:

- Signal level readings overlain on the floor plan
- Commissioning documents for the BDA
- GUI screenshots of system settings
- Product cutsheets.
- Retransmission agreement (from license holder)
- FCC Registration document

Building Owner Responsibilities

Keep on-site record of the project documentation, including but not limited to:

- As-built design
- Technical manuals
- Equipment locations
- AC circuit breaker location
- Annual inspection records
- Contact information of the System Maintenance Vendor

Ensure annual inspections are performed

Provide the AHJ with access to the facility for ERCES testing purposes

System Commissioning

Upon completion of the ERCES installation, the system must be commissioned and a close-out report written and submitted to the AHJ and other interested parties. The commissioning process consists of the testing of portable radio coverage, measurement of signal levels, validation of electronic monitoring of the 6 system functions, AGC operation and oscillating protection, overview of the system installation, confirmation of an adequate quantity of 2-hour rated cable and other items deemed essential by the AHJ.

A project close-out report will be provided to convey all technical documentation, performance results, equipment settings and others documentation as required by the AHJ.

SECTION 010130 - SUMMARY OF THE WORK - ASBESTOS ABATEMENT

UNION COLLEGE OF UNION COUNTY
FLOOR TILE & MASTIC ABATEMENT PROJECT

Part 1 - General

RELATED DOCUMENTS:
General provisions of Contract apply to work of this section.

PROJECT/WORK IDENTIFICATION:

General:
Project scope covers Removal of Asbestos Containing Floor Tile & Mastic in Union College, 1033 Springfield Avenue, Cranford, New Jersey 07016 as shown on Contract Document Addendum 001 prepared by Owner's Representative, RK Occupational & Environmental Analysis, Inc., dated June 11, 2025.

Contract Documents:
Indicate the work of the Contract and related requirements and conditions that have an impact on the project. Related requirements and conditions that are indicated on the Contract Documents include, but are not necessarily limited to the following:

Applicable codes and regulations.
Notices and permits.
Existing site conditions and restrictions on use of the site.
Work to be performed subsequent to work under this Contract.

Abbreviated Written Summary:
Briefly and without force and effect upon the contract documents, the work of the Contract can be summarized as follows.

1. Non-friable removal of asbestos containing floor tile & mastic in the following areas:
   Room C106, C107, C107 Closet, Coach's Office, Room C106/107 Hall, Gym Storage Room, & Boy's Locker Room Storage Closet.

THE WORK includes the non-friable removal of Category I asbestos-containing materials (ACM) according to the requirements of the following specification sections. On projects involving the removal of greater than 160 square feet of asbestos in a public school building, provisions of NJDOH recommended Guidelines for Non-Friable Removal of Floor Tile, EPA NESHAP (61.145 & Appendix A to Subpart M), Subchapter 8 of the N.J. Uniform Construction Code (5:23-8.22), and New Jersey Department of Environmental Protection & Energy (N.J.A.C. 7:26) shall apply as followed.

NON-FRIABLE removal of floor tile and mastic shall be interpreted from the "Recommended Work Practices for the Removal of Resilient Floor Coverings" as published by the Resilient Floor Covering Institute. EPA NESHAP as meaning ACM that will NOT become crumbled, pulverized, or reduced to powder during renovation operations. No visable emissions shall be created during removal operations. Radiant heat machines, partial containment enclosures, HEPA air filtration devises, HEPA vacuums and

pump sprayers shall also be utilized to contain the work and further ensure no visable emissions during removal operations.

010130-1

ABATEMENT PROCEDURES –FLOOR TILE, MASTIC

.01 Abatement within the *Union College* shall require construction of partial containment work areas for NON-FRIABLE removal of floor tile and mastic. The work area shall be secured and appropriate warning signs shall be posted. Shutdown all ventilation equipment serving the work area and install critical barriers on all penetrations into the work area. Hang 6-mil poly sheets four feet up on walls (in floor tile /mastic areas) to protect against mastic solvent splatter. A centralized two-stage shower decontamination unit is required for worker entry & exit. Set up negative HEPA air pressure units to maintain minimum air pressure differential of -0.02" water column. Solvent removal of mastic is acceptable provided a NO ODOR solvent, as approved by the Owner's representative, is used. Floor to be left in suitable condition for application of new flooring.

.02 The Owner's representative will perform daily PCM air testing during abatement activity and will provide final air clearance tests via TEM following completion of work. Air clearance will be collected inside the work area after floor tile and mastic are safely removed and have passed visual inspection by the Owner representative. Air Clearance criteria for all work areas shall be analyzed via TEM-AHERA methodology (5 inside, 5 outside, 3 blanks) as per EPA AHERA guidelines (40 CFR 763.90(i). Final TEM average air testing results of 70 structures/mm^2 or below allows area to be re-occupied. Turnaround time for air samples will be 24 hours.

.03 The following asbestos containing materials are scheduled for abatement:

TABLE NO. 1 - SUMMARY OF WORK
ASBESTOS CONTAINING MATERIALS TO BE ABATED

LOCATION / DESCRIPTION	RESPONSE	APPROXIMATE QUANTITY *
Floor Tile & Mastic		
1. Room C106 /12" Floor Tile & Mastic	Non-Friable Partial Containment	480 sq.ft.
2. Room C107/ 12" Floor Tile & Mastic	Non-Friable Partial Containment	732 sq.ft.
3. Room C107 Closet/12"Floor Tile & Mastic	Non-Friable Partial Containment	110 sq.ft.
3. Rm C106/C107 Hall/12"Floor Tile & Mastic	Non-Friable Partial Containment	260 sq.ft.
4. Coach's Office/ 12" Floor Tile & Mastic	Non-Friable Partial Containment	65 sq.ft.
5. Gym Storage Closet/12" Floor Tile & Mastic	Non-Friable Partial Containment	85 sq.ft.
5. Boy's Locker Rm Closet/9" Flr Tile & Mastic	Non-Friable Partial Containment	45 sq.ft.
	Total	**1777 sq.ft.**

*It is the responsibility of the bidder to verify the presence of materials and objects encountered within the indicated work areas, and to take all measurements for estimating total footage. The amounts given are approximations and any variation more or less shall NOT entitle contractor a price adjustment.

.04 If for any reason during the abatement project there is an air level above 0.01 fibers/cc (by PCM analysis or TEM analysis) in any clean area inside the building (outside the work area), the removal process shall be halted and immediate clean up of affected area shall start and additional air sampling shall be collected until air levels are below 0.01 fibers/cc.

.05 The Contractor will properly dispose of the asbestos materials and provide documentation of same as required by N.J.A.C. 7:26.

PLAN OF ACTION: MANDATORY
Contractor shall submit a detailed plan of the procedures proposed for use in complying with the requirements of this specification. The plan must be approved by the Owner's Representative prior to commencement of work. Include in the plan the following minimum requirements:

1. location and layout of decontamination areas
2. the sequencing of asbestos work
3. the interface of trades involved in the performance of work
4. the methods to be used to assure the safety of building occupants and visitors to the site
5. the disposal plan including location of approved disposal site
6. a detailed description of the methods to be employed to control pollution
7. expand upon the use of personal protective equipment, portable HEPA ventilation systems, closing out of the building's HVAC system, method of removal to prohibit visible emissions in work area, and packaging of removed asbestos debris

INSPECTION:
Prior to commencement of work, inspect areas in which work will be performed. Prepare a listing of damage to structure, surfaces, equipment or of surrounding properties which could be misconstrued as damage resulting from the work. Photograph or videotape existing conditions as necessary to document conditions. Submit to Owner's Representative prior to starting work.

POTENTIAL ASBESTOS HAZARD:
The disturbance or dislocation of asbestos-containing materials may cause asbestos fibers to be released into the building`s atmosphere, thereby creating a potential health hazard to workmen and building occupants. Apprise all workers, supervisory personnel, subcontractors and consultants who will be at the job site of the seriousness of the hazard and of proper work procedures which must be followed.

STOP WORK:
If the Owner, the Owner's Representative, or the Project Administrator presents a written stop work order to the Contractor, immediately and automatically stop all work. Do not recommence work until authorized in writing by Owner's Representative.

CONTRACTOR USE OF PREMISES:
General: The Contractor shall limit his use of the premises to the work areas indicated.

Use of the Site: Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.

Keep existing driveways and entrances serving the premises clear and available to the Owner and his employees at all times. Do not use these areas for parking or storage of materials.

Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas indicated. If additional storage is necessary obtain and pay for such storage off site.

Lock automotive type vehicles, such as passenger cars and trucks and other mechanized or motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place or accessible to unauthorized persons.

Contractor's Use of the Existing Building: Maintain existing building in a safe and weathertight condition th
roughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

Keep public areas such as hallways, stairs, elevator lobbies and toilet rooms free from accumulation of waste, rubbish or construction debris.

Smoking or open fires will not be permitted within the building enclosure or on the premises.

OWNER OCCUPANCY:

Building will be least occupied by Owner during the project to allow for construction and abatement. The work schedule shall be determined by mutual agreement by Owner and Contractor.

SUBMITTALS

Before the Start of Work: Submit the following to the Owner's Representative for review. Do not begin work until these submittals are returned with Owner's Representative's action stamp indicating that the submittal is returned for unrestricted use or final-but-restricted use.

Plan of Action: Submit as a written report in the same manner as product data.

Inspection: Report on inspection carried out as required by this section. Include copies of all photographs, video tapes, etc. Submit in the same manner as product data.

END OF SECTION - 010130

010130-4

SECTION 010920 - CODES, REGULATIONS, AND STANDARDS

UNION COLLEGE OF UNION COUNTY
FLOOR TILE & MASTIC ABATEMENT PROJECT

PART 1 - GENERAL

RELATED DOCUMENTS:
Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this section.

SUMMARY
This section sets forth governmental regulations and industry standards which are included and incorporated herein by reference and made a part of the specification. This section also sets forth those notices and permits which are known to the Owner and which either must be applied for and received, or which must be given to governmental agencies before start of work.

Requirements include adherence to work practices and procedures set forth in applicable codes, regulations and standards.

Requirements include obtaining permits, licenses, inspections, releases and similar documentation, as well as payments, statements and similar requirements associated with codes, regulations, and standards.

CODES AND REGULATIONS

General Applicability of Codes and Regulations, and Standards: Except to the extent that more explicit or more stringent requirements are written directly into the contract documents, all applicable codes, regulations, and standards have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith.

Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all applicable Federal, State, and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State, and local regulations. The Contractor shall hold the Owner and Owner's Representative harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of himself, his employees, or his subcontractors.

Federal Requirements: which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

OSHA: Occupational Safety and Health Administration
Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite, Final Rules; Title 29, Part 1910, Section 1001 and Part 1926, Section 1101 of the Code of Federal Regulations

Respiratory Protection
Title 29, Part 1910, Section 134 of the Code of Federal Regulations

Construction Industry
Title 29, Part 1926, of the Code of Federal Regulations

Access to Employee Exposure and Medical Records Title 29, Part 1910, Section 2 of the Code of Federal Regulations

Hazard Communication
Title 29, Part 1910, Section 1200 of the Code of Federal Regulations

Specifications for Accident Prevention Signs and Tags
Title 29, Part 1910, Section 145 of the Code of Federal Regulations

DOT: U.S. Department of Transportation
Hazardous Substances
Title 49, Part 171 and 172 of the Code of Federal Regulations

EPA U.S. Environmental Protection Agency
Asbestos Hazard Emergency Response Act (AHERA) Regulation
Asbestos Containing Materials in Schools Final Rule & Notice
Title 40, Part 763, Sub-part E of the Code of Federal Regulations

Training Requirements of (AHERA) Regulation
Asbestos Containing Materials in Schools Final Rule & Notice
Title 40, Part 763, Sub-part E, Appendix C of the Code of Federal Regulations

National Emission Standard for Hazardous Air Pollutants
National Emission Standard for Asbestos
Title 40, Part 61, Appendix A to Sub-part M (Revised Sub-part B) of the Code of Federal Regulations

State Requirements: which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

N.J. Department of Environmental Protection
N.J. Department of Labor

10 days prior notice required to:

New Jersey Department of Labor
Office of Asbestos Control & Licensing
28 Yard Avenue
Station Plaza One, 3rd Flr
Trenton, NJ 08625-0054

New Jersey Department of Health

Consumer, Environmental and Occupational Health Service
P O Box 369
Trenton, NJ 08625-0369

010920-2

Local Requirements: Abide by all local requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials.

STANDARDS:

General Applicability of Standards: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, all applicable standards have the same force and effect (and are made a part of the Contract Documents by reference) as if copied directly into the Contract Documents, or as if published copies are bound herewith.

Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all standards pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor shall hold the Owner and Owner's Representative harmless for failure to comply with any applicable standard on the part of himself, his employees, or his subcontractors.

Standards: which apply to asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

American National Standards Institute (ANSI)
1430 Broadway
New York, New York 10018
(212)354-3300

Fundamentals Governing the Design and Operation of Local Exhaust Systems: Publication Z9.2-79
Practices for Respiratory Protection: Publication Z88.2-80

American Society for Testing and Materials (ASTM)
1916 Race Street
Philadelphia, PA 19103
(215)299-5400

Safety and Health Requirements Relating to Occupational Exposure to Asbestos: E 849-82

EPA GUIDANCE DOCUMENTS: discuss asbestos abatement work or hauling and disposal of asbestos waste materials listed below for the Contractor's information only. These documents do not describe the work and are not a part of the work of this contract. EPA maintains an information number (800) 334-8571, publications can be ordered from (800) 424-9065 (554-1404 in Washington, DC):

Asbestos-Containing Materials in School Buildings - A Guidance Document. Part 1 & 2. (Orange Books) EPA C00090 (out of print)

Guidance for Controlling Asbestos-Containing Materials in Buildings (Purple Book) EPA 560/5-85-024
Friable Asbestos-Containing Materials in Schools: Identification and Notification Rule (40 CFR Part 763)

Evaluation of the EPA Asbestos-in-Schools Identification and Notification Rule. EPA 560/5-84-005.

Asbestos in Buildings: National Survey of Asbestos-Containing Friable Materials. EPA 560/5-84-006.

Asbestos in Buildings: Guidance for Service and Maintenance Personnel. EPA 560/5-85-018.

Asbestos Waste Management Guidance. EPA 530-SW-85-007.

Asbestos Fact Book. EPA Office of Public Affairs.

Asbestos in Buildings: Simplified Sampling Scheme for Friable Surfacing Materials.

Commercial Laboratories with Polarized Light Microscopy Capabilities for bulk asbestos identification.

A Guide to Respiratory Protection for the Asbestos Abatement Industry. EPA-560-OPTS-86-001

NOTICES:

U.S. ENVIRONMENTAL PROTECTION AGENCY

Send Written Notification as required by USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61, Subpart M) to the regional Asbestos NESHAPS Contact at least 10 days prior to beginning any work on asbestos-containing materials. Send notification to the following address:

Asbestos NESHAPS Notification
Air Compliance Branch
USEPA - Region 2
26 Federal Plaza, Room 500
New York, NY 10278
(877)251-4575 or (212) 637-3476

Notification: Include the following information in the notification sent to the NESHAPS contact:
Name and address of owner or operator.

Description of the facility being demolished or renovated, including the size, age, and prior use of the facility.

Estimate of the approximate amount of friable and/or non-friablr asbestos material present in the facility in terms of square or linear feet of facility components. For facilities in which the amount of friable asbestos materials less than 80 linear meters (260 linear feet) on pipes, less than 15 square meters (160 square feet) on other facility components, or 1 cubic meter explain techniques of estimation.

Location of the facility being demolished or renovated.

Scheduled starting and completion dates of demolition or renovation.

Nature of planned demolition or renovation and method(s) to be used.

Procedures to be used to comply with the requirements of USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61 Subpart M).

Name and location of the waste disposal site where the friable asbestos waste material will be deposited.

For facilities being demolished under an order of a State or local governmental agency, issued because the facility is structurally unsound and in danger of imminent collapse, the name, title, and authority of the State or local governmental representative who has ordered the demolition.

STATE AND LOCAL AGENCIES:

Send written notification as required by state and local regulations prior to beginning any work on asbestos-containing materials. This includes 10-day notices to NJDOH and NJDOL prior to starting work.

PERMITS: All asbestos containing waste is to be transported by an entity maintaining a current "Industrial waste hauler permit" specifically for asbestos-containing materials, as required for transporting of waste asbestos-containing materials to a disposal site.

LICENSES: Maintain current licenses as required by applicable state or local jurisdictions for the removal, transporting, disposal or other regulated activity relative to the work of this contract.

POSTING and FILING REGULATIONS: Post all notices requires by applicable federal, state and local regulations. Maintain two (2) copies of applicable federal, state and local regulations and standard. Maintain one copy of each at job site. Keep on file in Contractor's office one copy of each.

SUBMITTALS:

Before Start of Work: Submit the following to the Owner's Representative for review. No work shall begin until these submittals are returned with Owner's Representative's action stamp indicating that the submittal is returned for unrestricted use or final-but-restricted use.

Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work including:

State and Local Regulations: Submit copies of codes and regulations applicable to the work.

Notices: Submit notices required by federal, state and local regulations together with proof of timely transmittal to agency requiring the notice.

Permits: Submit copies of current valid permits required by state and local regulations.

Licenses: Submit copies of all State and local licenses and permits necessary to carry out the work of this contract.

END OF SECTION - 01092

SECTION 011000 – SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Project information.
2. Work covered by Contract Documents.
3. Contractor's use of site and premises.
4. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: UNION COLLEGE OF UNION COUNTY

1. Project Location: 1033 Springfield Ave, Cranford, NJ 07016

B. Owner: Union County Improvement Authority

C. Owner's Representative: MAST Construction Services, Inc.

1. Representative – Troy Marzziotti – tmarzziotti@mastconstruction.com

D. Architect: DIGroup Architecture

1. Architect's Representative: Madelyn Pena mpena@digrouparchitecture.com
2. Architect’s Project Number – 23.084

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage to be provided by the Owner.

1. See Section 013100 “Project Management and Coordination.” For requirements for using web-based Project software..

F. Project Description: Expansion of Union College’s Physical Education Center on their Cranford, NJ main campus. The project consists of an addition and renovation at the southwest end of their main campus building. The footprint of the addition is approximately 33,150 sf, consisting of a new gymnasium to replace the undersized, high school level gym currently being utilized along with a weight room, visiting team locker room, therapy rooms and the athletic success educational program classroom. The second floor of the addition is 1,900 sf, consisting of an egress corridor from the existing second floor building, officials lounge, stair and utility rooms. The remainder of the athletic spaces that exists in the current building will be renovated to provide locker rooms for men and women, adequate office space for program management

and sports officials, e-sports gaming competition area; wrestling room; multipurpose room; sports education training rooms and adequate storage and support areas.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Bid Documents and consists of the following:

1. Construction of a single-story addition, new gymnasium, infill of existing gymnasium, and refurbishment of the existing athletic facilities.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor’s use of the site shall be limited to the area of work. Contractor shall have full use of student parking lot 2.

1.5 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

C. Employee Identification: Contractor shall provide identification tags for personnel working on Project site. Require personnel to use identification tags at all times.

D. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

A. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

1.7 WORK SEQUENCE

A. The Contractor shall be responsible for coordinating the erection sequence of precast concrete wall panels and structural steel framing for the gymnasium. Due to structural and logistical requirements, the roof trusses may be required to be installed subsequent to the placement of precast panels. Where applicable, the Contractor shall provide all necessary temporary shoring and bracing to support structural steel members until the structure can be fully integrated with the roof trusses and full structural continuity is achieved.

B. Emergency Responder Communications Enhancement System (ERCES) Testing and Installation

1. **General Requirements**
   The General Contractor (GC) shall engage a licensed and qualified professional, certified in Emergency Responder Communications Enhancement Systems (ERCES), to perform all required testing and installation services in accordance with the project requirements.

2. **Scope of Work**
   The GC shall be responsible for all Emergency Radio coverage testing and the potential installation of an ERCES, as detailed in the Appendix document titled *"Emergency Responder Communications Enhancement System (ERCES) Requirements for Cranford, New Jersey."*

3. **Testing Requirements**

   - ERCES testing shall be **included in the base bid amount**.
   - Testing shall occur **prior to the installation of ceilings** in both alteration and addition areas.
   - Testing shall be conducted **after the completion of mechanical, electrical, and plumbing (MEP) system installations** to ensure accurate assessment of signal coverage.

4. **Installation and Allowance**

   - Should testing indicate the need for ERCES equipment and/or infrastructure, the associated equipment procurement and installation shall be executed under the **allowance**.
   - The allowance shall cover the cost of any new ERCES-related components, infrastructure, and associated installation services as required by the test results.

5. **Responsibility**
   All coordination, scheduling, and execution of ERCES testing and potential system installation shall be the sole responsibility of the General Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. General Allowance

C. Use the allowances only as directed by Owner for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance. Include allowances in the contractors bid.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

E. Do not include Contractor's or subcontractor's indirect expense (overhead & profit) in the Change Order cost amount. Overhead and profit will not be allowed when billing costs against the allowance. Contractors need to account for the overhead and profit for the contract allowance in their overall bid amount.

PART 2 - PRODUCTS

2.1 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: General Allowance

Include an allowance of $1,250,000 in the contractors bid (One million, two hundred and fifty thousand dollars) for contingency use by the Owner.

No other Allowances

END OF SECTION 012100

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.01 DEFINITIONS

A. Unit Price: An amount proposed by a bidder as a price per unit of measurement for a material or service.

B. Estimated Quantity: The anticipated amount of work in the units of measurement for a material or service.

C. Extended Price: The arithmetic product of the Unit Price and the Estimated Quantity.

D. Unit Price Schedule: A portion of the Bid Form that includes Unit Prices for Estimated Quantities of work for materials or services, and Extended Prices.

1.02 PROCEDURES

A. The purpose of unit prices is to establish prices for work for which the specific quantity is not known at the time of bid.

B. A unit price shall include all costs for material, labor, equipment, overhead, insurance, taxes, delivery fees, and any other costs associated with the work, as well as profit.

C. There are two types of unit prices.

1. A unit price may be for work fully-anticipated to be part of the contract, but for which the actual quantity is not known at the time of bid. This type of unit price has an estimated quantity of one (1) or more. The estimated quantity represents the University's best estimate of the amount of that particular work to be required. The Extended Price will be included as part of bid evaluation, and the Extended Price will be part of the contract price at time of contract award. This type of unit price also establishes a basis for payment, and a basis for equitable adjustment to the contract price in the event that the actual quantity of work is different than the estimated quantity of work.

2. A unit price may be for work not necessarily anticipated to be part of the contract, but which may be required during the contract. This type of unit price is based on a quantity of one (1), or a quantity that represents a commonly-accepted base quantity used in purchasing or installing that item if a quantity of one (1) is very small, and this type of unit price will not have an Extended Price. This unit price will not be included as part of bid evaluation, and this unit price will not be a part of the contract price at time of award. This type of unit price establishes a basis for equitable adjustment to the contract price in the event that the work is required. Unit prices of this type will be individually or wholly accepted or rejected at time of award.

D. For Unit Prices identified in paragraph 1.02 C. 1. above, the following apply.

1. If on the bid form submitted by the Contractor there is a discrepancy in correlation between a unit price and an extended price, the unit price shall govern.

2. If the actual quantity required during the contract is different from the estimated quantity, a

change in the contract price shall be executed. The change to the contract may include an increase or decrease in the contract time, if appropriate. If the difference between the actual and estimated quantities is significant enough such that the unit price no longer represents a fair and reasonable price for the actual quantity, an adjustment to the unit price may be negotiated upon request of either party.

3. The Contractor will be paid for unit price work on the basis of actual measured quantities of work satisfactorily performed. Quantities of work different than the estimated quantity shall be ordered in writing by the University.

E. For Unit Prices identified in paragraph 1.02 C. 2.. above, the following apply.

1. Although the unit price is based on an estimated quantity of one (1), or on a commonly-accepted base quantity, the actual work may involve significantly more units.

2. If the work is required, a change to the contract price shall be executed. The change to the contract price shall be established by the unit price, if accepted, and the actual quantity. For any unit price work for which there is not an accepted unit price, that unit price shall be negotiated prior to or at the time of the change order. The change to the contract may include an increase or decrease in the contract time, if appropriate.

3. The Contractor will be paid for unit price work on the basis of actual measured quantities of work ordered in writing by the University and satisfactorily performed.

F. In all cases, the following apply.

1. The University reserves the right to reject the Contractor's measurement of work associated with unit priced work, and may have the work measured by an independent agent acceptable to the Contractor at the University's expense.

2. Refer to Technical Specification sections for methods of measurement and payment for unit priced work, if applicable.

1.1 LIST OF UNIT PRICES

UNIT PRICES

Provide units prices to furnish and install the following items. These prices will be the agreed upon basis for potential additional work to be performed via change order as requested by and approved by the Owner. All Unit Prices include all costs associated with the work and includes overhead & profit

The cost per additional item will be calculated based on the unit prices indicated below and provided with the contractors bid submission.

A. Unit Price No. 1: 20A duplex Electrical Receptacle (each location) including a minimum of 50 feet of 2#12+1#12GND MC cable including supports, backbox, faceplate and all terminations fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each location: $ _____

B. Unit Price No. 2: 2#12+1#12GND MC cable including supports, in accordance with the specifications. Unit of Measurement: Per Linear Foot (LF).

Per Linear foot: $ _____

C. Unit Price No. 3: Tele/Data Jacks, including (2) RJ-45 CAT6 jacks, 250 feet each of (2) CAT6 cables including supports, terminations and testing fully complete, all in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

D. Unit Price No. 4: Exit Sign, fixture type "E1" including minimum of 50 feet of 2#12+1#12GND MC cable including supports, backbox and all terminations, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

E. Unit Price No. 5: Digital lighting control "CO1" including all sensors, wall button stations, power packs and programming fully complete, in accordance to the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

F. Unit Price 6: Fire Alarm Horn/Strobe, including 100 feet of 2#14 FPLP MC cable, backbox and terminations fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

G. Unit Price No. 7: Smoke Detector, Ceiling Mounted, including 100 feet of 2#16 FPLP MC cable, backbox and terminations fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

H. Unit Price No. 8: Multicriteria Detector (smoke and carbon monoxide), Ceiling Mounted, including 100 feet of 2#16 FPLP MC cable, backbox and terminations fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

I. Unit Price No. 9: 1" Copper Pipe Type L, including all supports, couplings and insulation fully complete, in accordance with the specifications. Unit of Measurement: Per Linear Foot (LF).

Per Linear foot: $ _____

J. Unit Price No. 10: 1" Ball valve fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

K. Unit Price No. 11: Galvanized Ductwork including 22 gauge duct, including internal lining, supports fully complete, in accordance to the specifications. Unit of Measurement: Pounds (LBS).

Per Pound: $ _____

L. Unit Price No. 12: 1-1/2" Exterior duct insulation wrap fully complete, in accordance with the specifications. Unit of Measurement: Per Square Foot (SF).

Per Square Foot: $ _____

M. Unit Price No. 13: HVAC controls points, including sensors (thermostats, humidity sensors, pressure sensors) and connect to the DDC system via plenum rated wiring and all programming fully complete, in accordance with the specifications. Unit of Measurement: Each (EA).

Each Location: $ _____

N. Unit Price No. 14: Access Panels

Each Location: $ _____

O. Unit Price No. 15: Removal and disposal of historic fill in excess of 11,000 Cubic Yards. It is estimated that 11,000 Cubic Yards of cut will be required for the project. Soil removal and disposal up to that amount are to be included in the contractor's bid. Note this is a Cubic Yard amount. The GC is to provide verification that removals have exceeded the required cubic yard volume before unit costs will be utilized. This unit price for additional removal and disposal of historic fill, if needed, and will be calculated by weight.

Cost per ton: $ _____

P. Unit Price No. 16: Importing certified clean fill in excess of 0 Cubic Yards. It is estimated that the import of 0 CY of certified clean fill will be required in the contractor's bid. This unit price for additional import of certified clean fill, if needed.

Cost per ton: $ _____

Q. Unit Price No. 17: Removal and disposal of excess contaminated soil not deemed to be historic fill.

Cost per ton: $ _____

END OF SECTION 012200

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in, materials, equipment, and methods of construction from those required by the Construction Documents and proposed by the Contractor after execution of the Construction Contract.

1. Substitutions for Cause: Changes proposed by the Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by the Contractor or Owner that are not required in order to meet other Project requirements but may offer an advantage to Contractor or Owner.
3. Substitutions prior to Bid: The owner will not review substitution requests by the Contractor during the RFP bid phase.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method can be used in lieu of what is indicated in Construction Documents.
b. Coordination of information, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Construction Documents. Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.

g. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
h. Research reports evidencing compliance with building code in effect for Project.
i. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

2. Owner's Action: If necessary, the Owner through the Owner's Rep and or Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. The Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

B. Substitutions for Convenience: Owner will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Owner will consider Contractor's request for substitution.

a. Requested substitution offers Owner a substantial advantage in, time, energy conservation, or other considerations.
b. Requested substitution is consistent with the Contract Documents and will produce indicated results
c. Substitution request is fully documented and properly submitted.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals of authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.
i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. Owner or Owner's Rep will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

B. Architect may issue Architect's Supplemental Instructions (ASI) to authorize minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

012900 - PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Change procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 21 00 - Allowances: Payment procedures relating to allowances.

B. Section 01 77 00 - Closeout Procedures: Project record documents.

1.03 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractors construction schedule.

A. Use Schedule of Values Form: AIA G703, current edition.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Submit Schedule of Values in duplicate within 15 days after date of Commencement of the Work.

E. Submit the schedule of values to Owners Rep at earliest possible date, but no later than 7 days before the date scheduled for submittal of initial Applications for Payment.

F. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization, bonds and insurance, and phased work.

G. Provide sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports and so that no line item exceeds five percent of the Contract Sum. Round amounts to nearest whole dollar, the total shall equal the Contract Sum.

H. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

I. Include within each line item, a direct proportional amount of Contractor's overhead and profit.

J. Revise schedule to list approved Change Orders, with each Application For Payment.

K. Closeout Costs: Include separate line items under Contractor and principal subcontracts for project closeout requirements in an amount totaling a minimum of 1% of Contract Sum and subcontract amount.

1.04 TAXES

A. The owner is exempt from any local, state or federal sales, use or excise tax. The owner will not pay for state sales and use tax that are included in any invoices.

1.05 APPLICATIONS FOR PROGRESS PAYMENTS

A. Each Application for Payment shall be in accordance with the agreed upon procedures and forms in the Owner-Contractor Agreement. In the event, agreement is silent on specific procedures, Contractor to follow protocols identified below.

B. Payment Period: Submit at intervals stipulated in the Agreement.

C. Use Form AIA G702/CMa and Form AIA G703, current edition.

D. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

E. Forms filled out by hand will not be accepted.

F. Execute certification by signature of authorized officer.

G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

I. Submit one electronic and three hard-copies of each Application for Payment.

J. Submit the following prior to the first Application for Payment. No payment will be approved until these have been submitted.
   1. Evidence of Affirmative Action Compliance.
   2. Proof of Business Registration.
   3. Copy of the building permit.
   4. Name and qualifications of a proposed superintendent.
   5. Names of persons or entities proposed for each principal portion of the Work.
   6. Submittal schedule.
   7. Schedule of values.
   8. Insurance certificates naming the Owner, Architect, and Architect’s consultants as additional insureds under the Contractor’s commercial general liability policy.

K. Include the following with each application during construction:
   1. Transmittal letter as specified for submittals in Section 01 30 00.
   2. Construction progress schedule revised and current as specified in Section 01 32 16.
   3. Current construction photographs specified in Section 01 30 00.
   4. Partial release of liens from major subcontractors and vendors.
   5. Certified payrolls General Contractor is required to upload Certified Payrolls to New Jersey Wage Hub on a monthly basis and provide hard copies with their submission of payment requisition.
   6. Affidavits attesting to off-site stored products.

7. Updated Construction Schedule
8. Daily Construction Reports
9. Updated Change Order Log

L. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.06 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 14 days.

D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation . Document any requested substitutions in accordance with Section 01 25 00.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

F. Substantiation of Costs: Provide full information required for evaluation.
1. Provide the following data:
   a. Quantities of products, labor, and equipment.
   b. Taxes, insurance, and bonds.
   c. Overhead and profit.
   d. Justification for any change in Contract Time.
   e. Credit for deletions from Contract, similarly documented.
2. Support each claim for additional costs with additional information:
   a. Origin and date of claim.
   b. Dates and times work was performed, and by whom.
   c. Time records and wage rates paid.
   d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

G. Overhead and Profit:

1. For all extra Work performed by Contractor:
   a. The gross cost to the Owner shall include the net cost of the Work to the Contractor plus an allowance for overhead and profit (inclusive of bond and insurance) not to exceed 15% of the net cost.
2. For all extra Work performed by a Subcontractor:
   a. The gross cost to the Owner shall include the net cost of the Work to the Subcontractor plus an allowance for overhead and profit not to exceed 10% of the net cost, plus the Contractor's overhead and profit (inclusive of bond and insurance) not to exceed 10% of the Subcontractor's cost (for a maximum aggregate total of 21%).

H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

K. Promptly enter changes in Project Record Documents.

1.07 APPLICATION FOR FINAL PAYMENT

A. Forms:
1. AIA G706 “Contractor’s Affidavit of Payment of Debts and Claims
2. AIA Document G706A “Contractor’s Affidavit of release of Liens”
3. AIA Document G707 “Consent of Surety to Final Payment”

B. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

C. Application for Final Payment will not be considered until the following have been accomplished:
1. All closeout procedures specified in Section 01 77 00.
2. Conditions listed in AIA Document A201 § 9.10.2.
3. Pursuant to N.J.S.A. 52:32-44, submit a complete and accurate list of all subcontractors used and their addresses.
4. Completion of items specified for completion after Substantial Completion.
5. Ensure that unsettled claims will be settled.
6. Ensure that incomplete Work is not accepted and will be completed without undue delay.
7. Transmittal of required Project construction records to the Owner.
8. Certified property survey (if applicable).
9. Proof that taxes, fees, and similar obligations were paid.
10. Removal of temporary facilities and services.
11. Removal of surplus materials, rubbish, and similar elements.
12. Completion of training necessary for the Owners personnel to operate all systems trouble-free.
13. Execution of maintenance agreements and assurance that maintenance is on-going.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROGRESS PAYMENTS PROCEDURE

A. Submit applications for payment within the time period stipulated in the Agreement.

B. The Architect will review and respond to the application within the time period stipulated in the Agreement.

C. The Owner will make payment within 30 days of the date established for the progress payment.

D. If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received.

E. The Contractor shall pay each Subcontractor, no later than ten days after receipt of payment from the Owner.

END OF SECTION

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Project meetings.

B. Related Requirements:

1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
2. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.2 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.

1.3 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.

3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.4 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1.5 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, the Contractor shall prepare and submit an RFI in the form specified.

1. The Architect will return without response those RFIs submitted to the Architect by other entities controlled by Contractor.
2. Post award RFI's between the Architect and the Contractor, including subcontractors, must include a copy to the Owner's rep.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation.

C. RFI Forms: Use RFI form issued for questions regarding the-Contract Documents.

D. Architect's Action: The Architect will review each RFI, determine action required, and respond within 10 business days.

1. The following Contractor-generated RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by the Architect of additional information.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly during construction with a copy to the owner. Use software log that is part of web-based Project management software Include the following:

1. Project name.

2. Name and address of Contractor.
3. Name and address of the Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of the Architect's action, update the RFI log and immediately distribute the RFI response to affected parties.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of the Architect's Digital Data Files: Digital data files of the Architect's electronic drawings will be provided by the Architect for the Contractor’s use in preparing coordination and shop drawings after Contract Award. A waiver form issued by the Owner/Architect must be executed before drawings are released.

1.7 PROJECT MEETINGS

A. General: Owner will schedule and designate location of project construction meetings.

B. Preconstruction Conference: Owner will schedule a preconstruction conference before starting construction, at a time convenient to Owner , but no later than 15 days after execution of the Agreement.

1. Minutes: Contractor will record and distribute meeting minutes.

C. Progress Meetings: Construction Manager will conduct progress meetings at intervals identified in the Owner/Contractor Agreement.

1. Coordinate dates of meetings with preparation of payment requests.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.

B. GENERAL: Scheduling of the Services and Work is and shall be the Contractor’s Responsibility. The Contractor shall appoint a CPM Scheduler designated by the Contractor as the preparer and maintainer of all Critic Path Method schedules for the project, including the Initial Milestone Schedule; and the Construction Schedule.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

F. Fragnet – A subset of a project schedule that sets forth the sequencing of all critical and non-critical activities

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.

B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at monthly intervals.

G. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

A. Contractor to coordinate the Construction Schedule with the schedule of values submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for the notice to proceed to final completion.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work.

1. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
2. Commissioning Time: Include no fewer than 15 days for commissioning.

3. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Owners administrative procedures necessary for certification of Substantial Completion.
4. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update.

E. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

G. Distribution: Distribute copies of approved schedule to Owner, separate contractors, testing and inspecting agencies, and other parties identified by the Owner with a need-to-know schedule responsibility.

1.6 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 30 days of date established for the Notice of Award. Outline significant construction activities for the first 90 Insert number days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.

1. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and inspection.
    j. Commissioning.
    k. Punch list and final completion.
    l. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.

3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.

4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

1.7 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Final completion construction photographs.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
3. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web- based Project management software site:

a. Name of Project.
b. Name of Redeveloper.
c. Date photograph was taken.
d. Description of location, vantage point, and direction.
e. Unique sequential identifier keyed to accompanying key plan.

1.3 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.4 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties.

D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work.

E. Periodic Construction Photographs: Take photographs coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take photographs after date of Substantial Completion for submission as Project Record Documents.

G. Construction Site Video Monitoring

1. The Contractor is to provide site camera system featuring two (2) 18.0 megapixel digital SLR camera and a dependable Linux computer system. The cameras are to be all-weather cameras which automatically capture snapshots on a schedule and installed to provide opposing views. A cellular modem (Verizon, Sprint, AT&T, or Global/SIM card) is to be built into the camera system to transmit (via FTP) live images from the jobsite over the internet to your computer.

2. The Contractor shall provide a High Definition Megapixel Web Camera which shall provide a full view of the work area on the construction jobsite. The Web Camera shall allow users to remotely view the project on a secure connection via a network connection.

3. Basis of Design: Work Zone Cam 877-966-3101 WWW.WORKZONECAM.COM or equal.

4. The Web Camera shall meet or exceed the following requirements:
   a. Thermostatically controlled enclosure with heater and blower
   b. Powder coated aluminum housing with stainless steel fittings for padlocks
   c. Canon digital SLR camera with 18 Megapixel images (5184 x 3456 pixels), APS-C imager
   d. Angle of view: wide 63° horizontal – 44° vertical, full zoom 22° horizontal - 15° vertical
   e. Auto Features: ISO speed, metering mode, white balance, and focus
   f. EF-S 18mm-55mm f/3.5-5.6 Image Stabilization STM lens
   g. Professional photo grade lens window
   h. Omni-directional power indicator lamp will illuminate green
   i. Two UL rated compression glands, gas spring lid, adjustable camera sled
   j. Compression: JPEG/RAW
   k. 4GB onboard storage
   l. 12VDC Solar Power
   m. Communications 10base-T/100base-TX Ethernet, IP Addressing: Dynamic or Static
   n. Wireless cellular modem EVDO REV.A full duplex transceiver with GPS and exterior outdoor antenna

5. Online Web Interface: The Web Camera will function via a web-based interface to allow the viewing of all High Definition still images captured and stored from any location with internet access.

The Online Web Interface shall include:

a. Company logo and project name
b. Multiple tabs option for accessing multiple cameras from one page
c. Digital Pan, Tilt, and Zoom capability within a High Definition image
d. Easy navigation with intuitive image calendar control
e. Automated image geotagging with camera location
f. Downloadable up-to-date high quality time-lapse movies with embed code for adding the time-lapse to websites
g. Image Comparison Tool for overlaying two images from different dates and times for comparison
h. Share Image Tool for saving and emailing
i. Local weather data
j. Map integration of GPS data showing camera location
k. Multiple website themes with option to personalize background
l. Administrative controls for the client, allowing them to customize public access page, including project name, camera name configuration and username management with three levels of password protection.

6. The system shall capture and upload images every 30 minutes, 24 hours per day.

7. The System Vendor will maintain images on their servers for reference available to the Authority, CM and Bridging Architect, at all times during the life of the project. All images will be protected on secure fully redundant servers at multiple locations owned and operated by the System Vendor.

8. The System Vendor shall provide an embed code or web interface link with Design Builder's project details for unlimited public or private access.

9. The Contractor shall secure a nearby structure for camera mounting or provide a fixed pole (40 feet/12 meters height recommended and 3 inches/8centimeters minimum diameter) as per System Vendor's instruction. The Contractor shall supply all equipment required for safe and secure access to the camera location, including building access, bucket truck and/or lift, for technicians performing installation and maintenance services.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:

1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
2. Division 01 Section "Closeout Procedures" for submitting warranties.
3. Divisions 02 through 16 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect’s responsive action.

B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 7 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 7 working days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is required, allow 14 working days for initial review of each submittal.

5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 14 working days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

E. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information on label for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name and address of Contractor.
    e. Name and address of subcontractor.
    f. Name and address of supplier.
    g. Name of manufacturer.
    h. Submittal number or other unique identifier, including revision identifier.

        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

    i. Number and title of appropriate Specification Section.
    j. Drawing number and detail references, as appropriate.
    k. Location(s) where product is to be installed, as appropriate.
    l. Other necessary identification.

F. Deviations: Encircle or otherwise specifically identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.

1. Transmittal Form: Use facsimile of sample form at end of Section.
2. Transmittal Form: Provide locations on form for the following information:

    a. Project name.
    b. Date.
    c. Destination (To:).
    d. Source (From:).
    e. Names of subcontractor, manufacturer, and supplier.
    f. Category and type of submittal.
    g. Submittal purpose and description.
    h. Specification Section number and title.
    i. Drawing number and detail references, as appropriate.
    j. Transmittal number, numbered consecutively.
    k. Submittal and transmittal distribution record.
    l. Remarks.
    m. Signature of transmitter.

3. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "Approved As Noted” from Architect's action stamp."

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Use only final submittals with mark indicating "Approved As Noted” from Architect's action stamp" taken by Architect.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

1. CAD files may be formatted for specific use on this project for a cost of $250 per drawing file.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Submit electronic submittals directly to extranet specifically established for Project.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Standard color charts.
e. Manufacturer's catalog cuts.
f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Mill reports.
j. Standard product operation and maintenance manuals.
k. Compliance with specified referenced standards.
l. Testing by recognized testing agency.
m. Application of testing agency labels and seals.
n. Notation of coordination requirements.

4. Submit Product Data before or concurrent with Samples.
5. Number of Copies: Submit 3 (three) copies of Product Data, unless otherwise indicated. Architect will return 2 (two) copies. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Architect's CAD Drawings are otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shopwork manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.
m. Relationship to adjoining construction clearly indicated.
n. Seal and signature of professional engineer if specified.
o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
3. Number of Copies: Submit two opaque (bond) copies of each submittal. Architect will return one copy.
4. Number of Copies: Submit 3 (three) opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Submit 5 (five) copies where copies are required for operation and maintenance manuals. Architect will retain 2 (two) copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit 1 (one) full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit 3 (three) sets of Samples. Architect will retain 2 (two) Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least 3 (three) sets of paired units that show approximate limits of variations.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.
4. Number of Copies: Submit 3 (three) copies of product schedule or list, unless otherwise indicated. Architect will return 2 (two) copies.

    a. Mark up and retain one returned copy as a Project Record Document.

F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Construction Manager's action.

G. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

H. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

I. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Number of Copies: Submit 3 (three) copies of subcontractor list, unless otherwise indicated. Architect will return 2 (two) copies.

    a. Mark up and retain one returned copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit 2 (two) copies of each submittal, unless otherwise indicated. Architect will not return copies.
2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

V. Construction Photographs: Comply with requirements specified in Division 01 Section "Photographic Documentation."

W. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.

1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

2.3 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit 3 (three) copies of a statement, signed and sealed by the responsible design

professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. “Approved”, “Approved As Noted”, “Approved As Noted-Resubmit”, and “Disapproved – Resubmit”.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit the Contractor of other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for the Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of 5 previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: The Contractor or another entity engaged by the Contractor as an employee, SubContractor, or Sub-SubContractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
2. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to

NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. The Contractor’s quality-control services do not include contract administration activities performed by Architect[or Construction Manager].

1.3 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of the Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to the Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Owner regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections.

1. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. Other required items indicated in individual Specification Sections.

1.6 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.7 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor’s responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Contractor to Engage a qualified testing agency to perform quality-control services.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

PART 4 - REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

B. Repair and protection are the Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01400

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014339 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.

2. Integrated Interior mockups.

1.2 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements consisting of multiple products, assemblies, and subassemblies.

B. Integrated Interior Mockups: Mockups of prime interior spaces as freestanding temporary built elements consisting of multiple products, assemblies, and subassemblies for the following areas:

C. Contractor is responsible to remove and dispose of all mockups after review and approval at no cost to the Owner

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1.4 QUALITY ASSURANCE

END OF SECTION 014339

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of each prime contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection.

B. Temporary utilities include, but are not limited to, the following:

1. Water service and distribution.
2. Temporary electric power and light.
3. Temporary heat.
4. Ventilation.
5. Sanitary facilities, including drinking water.
6. Storm and sanitary sewer.

C. Support facilities include, but are not limited to, the following:

1. Field offices and storage sheds.
2. Temporary roads and paving.
3. Dewatering facilities and drains.
4. Temporary enclosures.
5. Hoists and temporary elevator use.
6. Temporary project identification signs and bulletin boards.
7. Waste disposal services.
8. Rodent and pest control.
9. Construction aids and miscellaneous services and facilities.

D. Security and protection facilities include, but are not limited to, the following:

1. Temporary fire protection.
2. Barricades, warning signs, and lights.
3. Sidewalk bridge or enclosure fence for the site.
4. Environmental protection.
5. Construction enclosure fence and gates
6. Temporary exitways

1.3 REGULATIONS

A. Comply with applicable laws and regulations.

B. Storage and Fabrication Sheds: Install sheds, equipped to accommodate materials and equipment involved. Sheds may be open shelters or enclosed spaces within the building.

C. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures. Install where facilities will best serve the Project. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.

D. Toilets: Install self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material. Use of pit-type privies will not be permitted.

E. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up. Dispose of drainage properly. Supply cleaning compounds.

F. Drinking Water Facilities: Provide containerized tap-dispenser bottled-water type drinking water units.

G. Collection and Disposal of Waste: Collect waste daily. Comply with NFPA 241 for removal of combustible waste. Enforce requirements strictly. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose in a lawful manner.

1.4 USE CHARGES

A. General: cost or use charges for temporary facilities are **not** chargeable to the Owner or the Architect. The Architect will not accept a prime contractor's cost or use charges for temporary services or facilities as a basis of claim for an adjustment in the Contract Sum or the Contract Time.

B. Water, Sewer, and Electric Power Service: Pay use charges for water, sewer, and electric power use by all entities for construction operations.

C. Other entities using temporary services and facilities include, but are not limited to, the following:

1. Sub- contractors.
2. The Owner's work forces.
3. The Architect.
4. **The Construction Manager.**
5. Testing agencies.
6. Personnel of government agencies.

1.5 SUBMITTALS

A. Temporary Utilities: The contractor shall submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Within 15 days of the date established for submittal

of the Contractor's Construction Schedule, the contractor shall submit a schedule indicating implementation and termination of each temporary utility for which the contractor is responsible.

1.6 QUALITY ASSURANCE

A. Regulations: The contractor shall comply with industry standards and with applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:

1. Building code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, fire department and rescue squad rules.
5. Environmental protection regulations.

B. Standards: The contractor shall comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."

1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with the normal application of trade regulations and union jurisdictions.
2. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

A. Temporary Utilities: The contractor shall prepare a schedule indicating dates for implementation and termination of each temporary utility for which the contractor is responsible. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.

1. Temporary Use of Permanent Facilities: The Installer of each permanent service shall assume responsibility for its operation, maintenance, and protection during use as a construction facility prior to the Owner's acceptance, regardless of previously assigned responsibilities.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: The contractor shall provide new materials. If acceptable to the Architect, undamaged, previously used materials in serviceable condition may be used. Provide materials suitable for use intended.

B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."

1. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sizes and thicknesses indicated.
2. For fences and vision barriers, provide minimum 3/8-inch- thick exterior plywood.
3. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch- thick exterior plywood.
4. For temporary interior partitions and enclosure walls provide ½" thick fire rated plywood one side, over ½" type "X" gypsum board securely fastened to both sides of 20 Ga. 4" metal studs at 16" o.c. – (1) hr fire rating. Run the plywood up to 8'-0" AFF. Run the gypsum boards up to the deck above. Doors and frames to be (1) hr rated hollow metal knock down type – "B" label. Provide R-11 fiberglass batt insulation at temporary partitions and enclosure walls located at exterior walls.

C. Roofing Materials: Provide UL Class A standard-weight asphalt shingles or UL Class C mineral-surfaced roll roofing on roofs of job-built temporary offices, shops, and sheds.

D. Paint: Comply with requirements of Division 9 Section "Painting."

1. For sign panels and applied graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
2. For interior walls of temporary offices, provide 2 coats interior latex-flat wall paint.

E. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.

F. Water: Provide potable water approved by local health authorities.

G. Open-Mesh Fencing: Provide 0.12-inch thick, galvanized 2-inch chainlink fabric fencing 8 feet high with galvanized looped-wire top strand (not barbed) and galvanized steel pipe posts, 1-1/2 inches I.D. for line posts, bottom and top rails and 2-1/2 inches I.D. for corner posts.

2.2 EQUIPMENT

A. General: The contractor shall provide new equipment. If acceptable to the Architect, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.

B. Water Hoses: Provide 3/4-inch heavy-duty, abrasion-resistant, flexible rubber hoses 100 feet long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge. It shall be the Contractor's responsibility to provide the necessary measures to keep the water hoses, along with the temporary water system piping, from freezing. The Contractor shall also be responsible to shut down the temporary water system at the supply valve at the end of each day's work for as long as temporary water is provided. No contractor shall modify the temporary water system without

consulting with, and obtaining approval in writing from the Contractor.

C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.

G. Temporary Offices: The contractor shall provide its own mobile units as specified elsewhere in this Section.

H. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

I. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures.

    1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required at no additional cost to the Owner.

B. The Contractor shall provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.

B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.

1. Sterilization: Sterilize temporary water piping prior to use.

C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.

1. Install electric power service underground, except where overhead service must be used.
2. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 V, ac 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

D. Temporary Lighting: When an overhead floor or roof deck has been installed, provide temporary lighting with local switching.

1. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.

E. Temporary Heat: Provide temporary heat required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize energy consumption.

1. Temporary heat shall be provided after enclosure of building in accordance with the activity milestone schedule. Building enclosure means a completely weathertight building. The General Contractor shall furnish and pay for all costs including but not limited to fuel and standby personnel as may be required for providing temporary heat, cooling and humidity control via the permanent heating system until Substantial Completion.

F. Heating Facilities: Except where the Owner authorizes use of the permanent system, provide vented, self-contained, LP-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open flame, or salamander-type heating units is prohibited.
2. The Owner will pay the cost for the temporary heat from the point in time when the

building's permanent heating system is used to provide temporary heating. The Mechanical Contractor shall replace the filters and thoroughly clean the HVAC units used for temporary heat. Filters used for this purpose shall not be taken from the number required by the Contract Documents.

G. Sanitary facilities include temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material.

H. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.

1. Provide separate facilities for male and female personnel.

I. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.

1. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

J. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.3 SUPPORT FACILITIES INSTALLATION

A. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.

1. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

B. Provide incombustible construction for offices, shops, and sheds located within the construction area or within 30 feet of building lines. Comply with requirements of NFPA 241.

C. Field Offices: The General Contractor shall provide an insulated, weathertight temporary office of sufficient size to accommodate required office personnel at the Project Site. Keep the office clean and orderly for use for small meetings. Furnish and equip offices as follows:

1. Furniture: Furnish with a desk and chairs, a 4-drawer file cabinet, plan table, plan rack, and a 6-shelf bookcase.

2. Equip with a water cooler and private toilet complete with water closet, lavatory, and medicine cabinet unit with a mirror.

3. The Contractor's field office shall be a new or reconditioned trailer. Minimum size 10' x 40'

a. Provide heating sufficient to maintain a minimum of 70F interior temp during the winter. Provide air conditioning sufficient to maintain a maximum of 75F interior temp during the summer.

b. Provide adequate space for a meeting area and provide the following furnishings:
One 12' x 3' conference table and twenty padded folding chairs.

c. Provide adequate furnishings and equipment to meet all contract requirements of your work.

D. Construction Manager Field Office: The Contractor shall also provide in his base bid, the cost to provide and maintain in good condition one (1) field office trailer for the exclusive use by the Construction Manager. The field office shall be ready no later than thirty (30) days after Notice to Proceed, and it is estimated that the field office will be required until such time that interior construction will allow for a space to be used for a temporary field office.

The Construction Manager's Field Office trailer shall have a floor area of not less than 420SF (12' x 35') and a ceiling height of 7 ½ feet, having two (2) partitions and doors providing three (3) rooms, two (2) for offices and the other to hold meetings. The field office shall have one (1) clothes closet of ample size and all stairs shall have safety rails installed. The bathroom should be **winterized and** in good working order for the project duration. The Contractor will be responsible to install and pay for all utilities for the trailer for the project duration and will be required to disconnect all utilities upon project completion. Doors and windows shall be equipped with adequate locks and all keys shall be given to the Construction Manager.

The Contractor shall also provide the following items and equipment in the Construction Manager's Field Office as part of the Contractor's Base Bid.

1. Trailer delivery, permit as required, setup, and removal of all at the end of the project. The trailer is to include stairs, ramp and self-contained toilet room with weekly service and supplies.

2. Provide heating sufficient to maintain a minimum of 70F interior temp during the winter. Provide air conditioning sufficient to maintain a maximum of 75F interior temp during the summer.

3. Provide the following equipment and services:
   a. One (1) programmable Masterlock Model # 175-D locks or equal
   b. Water cooler *I* refrigerator combination with bottled water service.
   c. Weekly cleaning/ janitorial service of the trailer.
   d. Electric~~,~~and internet service, including use charges.
   e. Provide coffee machine with coffee service for project duration.
   f. 1.1 cubic foot or larger microwave oven.
   g. 4.5 cubic foot or larger refrigerator

4. Provide the following equpment and services:
   a. Two Hon 38000 series 3'x6' metal desks or equal.
   b. Two Hon executive high-back swivel chairs and two Hon side chairs or equal.
   c. Two Mayline Ranger 3' x 5' drafting tables with a swivel stool or equal.
   d. One Safeco or equal mobile plan rack with twelve 30" sticks and twelve 36" sticks
   e. Two Hon 600 series or equal 36" wide legal 4 drawer lateral file cabinets with

locks and hanging file folders.
f. One 36"x48" commercial grade melamine dry-erase board and a four (4) pack of assorted color dry-erase markers.
g. One metal bookshelf with 4 shelves (min of201f).
h. One Acme 300 or equal First Aid kit.
I. Two (2) trash receptacles.
j. Conference table and 10 folding chairs
k. Fire extinguishers

5. Provide the following equipment for the construction manager's exclusive use:
   a. Telephone equipment and service:
   b. An internet service provider (ISP) account with FIOS, cable modem or broadband service, with a static LP. Address and wifi capability..
   c. One surge protector, with 6 ac outlets and 1 tele/fax protection.
   d. One commercial grade MFP copier/scanner (J lxl 7, 30ppm) **including 11"x17" paper capacity**, automatic feeder, 10 bin sorter, stapler and stand.
   e. One HP OfficeJet Pro 7740 All in One office machine or equal
   f. One Linksys WRT3200ACM AC3200 MU-MIMO Gigabit Wi-Fi Router or equal.
   g. One trash receptacle.

6. Provide, pay, assemble, install and maintain all service, support, supplies, bathroom supplies, cables, consumables, ink, paper, folders, utilities, film and development, usage charges, warranty and maintenance required to operate aforementioned equipment and facility.

7. All facilities, equipment and furnishings are to be provided, assembled and installed within fourteen (14) days of the Notice to Proceed. No payments will be released to the Contractor until this contract requirement is satisfied and all facilities are fully operational. All facilities, equipment and furnishing are to remain on site until thirty days after punch list completion, or sooner if directed by the Construction Manager and, at that time, all furnishings and equipment as previously listed will be transferred to the Owner.

E. Web-based Project Software: The Contractor is required to utilize the Construction Manager's Project Management Software: **Autodesk** Contract Management Program) through the enitre duration of the project for the submisison of all documents which inlcude but are not limited to RFI's and submittals. **Autodesk** will be administered by the Construction Manager for the project.

F. Storage and Fabrication Sheds: Install storage and fabrication sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on-site.

G. Temporary Paving: Construct and maintain temporary roads and paving in and around the construction area as necessary to accommodate delivery and storage of materials and equipment usage during the construction period. Locate temporary paving for roads, storage areas, and parking where the same permanent facilities will be located. Review proposed modifications to permanent paving with the Architect.

1. Paving: Comply with Division 2 Section "Hot-Mixed Asphalt Paving" for construction and maintenance of temporary paving.

2. Coordinate temporary paving development with subgrade grading, compaction, installation and stabilization of subbase, and installation of base and finish courses of permanent paving.

3. Install temporary paving to minimize the need to rework the installations and result in permanent roads and paved areas without damage or deterioration when occupied by the Owner.

4. Delay installation of the final course of permanent asphalt concrete paving until immediately before Substantial Completion. Coordinate with weather conditions to avoid unsatisfactory results.

H. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 2 Sections. Where feasible, use the same facilities. Maintain the site, excavations, and construction free of water.

I. Temporary Enclosures: Provide temporary enclosure for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 sq. ft. or less with plywood or similar materials.
3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.

4. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use UL labeled, fire-retardant-treated material for framing and main sheathing.

J. Temporary Lifts and Hoists: Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

K. Temporary Site Lighting: Install exterior yard and sign lights so signs are visible when Work is being performed.

L. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

M. Rodent and Pest Control: Before deep foundation work has been completed, retain a local

exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Employ this service to perform extermination and control procedures at regular intervals so the Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

N. Project Identification Sign: Prepare a project identification sign of the size indicated below, and install where directed to inform the public of the Project. Support on posts or framing of preservative treated wood. Do not permit installation of unauthorized signs.

1. Project Identification Sign: The Contractor shall prepare (1) project identification sign. Engage an experienced sign painter to paint graphics on sign. Graphics to be provided by Architect at shop drawing stage of project. Construct sign of treated wood framing and posts, ¾" plywood panels of exterior type Grade B-C sanded two sides, 4'-0" high x 8'-0" wide in size.

   Sign shall be hand painted or digital printed image with white background, black letters, name and location of project, name of Owner, listing of Owner board members and/or trustees, listing of project Engineers, and the Architects logo. Structure and supports shall be suitable for size of sign, and shall be detailed by sign manufacturer. The Contractor shall obtain all permits and variances if necessary for sign. Fabricate only after shop drawing has been approved. Do not permit installation of unauthorized signs.

   If Owner does not require Project Sign, Contractor shall provide credit back to the Owner via change order.

2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Architect.

B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10, "Standard for Portable Fire Extinguishers," and NFPA 241, "Standard for Safeguarding Construction, Alterations, and Demolition Operations."

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.

4. If required by the Local Authority Having Jurisdiction, Contractor is responsible to

furnish and install a Temporary Standpipe during Construction.

C. If required by the Local Authority, Contractor shall provide for uniformed police officers to direct traffic during roadway closures.

D. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition. Permanent Fire Protection: At the earliest feasible date in each area of the Project, complete installation of the permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

E. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.

F. Enclosure Fence: When excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.

1. Provide 8’-0” high open-mesh, chainlink fencing with posts set in a compacted mixture of gravel and earth. Provide fencing with no exposed barbs at top of fence.

G. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.

1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

H. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid using tools and equipment that produce harmful noise. Restrict use of noise-making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities and good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

2. Protection: Prevent water-filled piping from freezing. Maintain markers for

underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of the Contractor. The Owner reserves the right to take possession of project identification signs.

2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at the temporary entrances, as required by the governing authority.

3. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:

   a. Replace air filters and clean inside of ductwork and housings.

   b. Replace significantly worn parts and parts subject to unusual operating conditions.

   c. Replace lamps burned out or noticeably dimmed by hours of use.

After the permanent heating, cooling and humidity control system is generally ready for use and the conditions of construction requires continuous 24 hour heat and cooling and humidity control in the building, the Contractor's HVAC Subcontractor shall provide, operate and maintain temporary systems to provide required temperatures and humidity for the conduct of the work. This service shall be continued until the permanent system has been completely installed and in operation and the project completed. The Contractor's HVAC Subcontractor is to provide all warranties beginning from date of Substantial completion, not the date of temporary heating / cooling. Additional costs (if required) for extending these warranties are to be included in the contractors bid.

END OF SECTION
01500

SECTION 015723 - TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Temporary stormwater pollution controls.

1.2 STORMWATER POLLUTION PREVENTION PLAN

A. The Stormwater Pollution Prevention Plan (SWPPP) is part of the Contract Documents and is bound into this Project Manual.

1.3 QUALITY ASSURANCE

A. Stormwater Pollution Prevention Plan (SWPPP) Coordinator: Experienced individual or firm with a record of successful water pollution control management coordination of projects with similar requirements.

1. SWPPP Coordinator shall complete and finalize the SWPPP form.
2. SWPPP Coordinator shall be responsible for inspections and maintaining of all requirements of the SWPPP.

B. Installers: Trained as indicated in the SWPPP.

PART 2 - PRODUCTS

2.1 TEMPORARY STORMWATER POLLUTION CONTROLS

A. Provide temporary stormwater pollution controls as required by the SWPPP.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with all best management practices, general requirements, performance requirements, reporting requirements, and all other requirements included in the SWPPP.

B. Locate stormwater pollution controls in accordance with the SWPPP.

C. Conduct construction as required to comply with the SWPPP and that minimize possible contamination or pollution or other undesirable effects.

1. Inspect, repair, and maintain SWPPP controls during construction.

a. Inspect all SWPPP controls not less than every seven days, and after each occurrence of a storm event, as outlined in the SWPPP.

D. Remove SWPPP controls at completion of construction and restore and stabilize areas disturbed during construction.

END OF SECTION 015723

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1.4 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that meet the performance specifications and intent identified in the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Owner will consider Contractor's request for comparable product if it meets the performance criteria and intent of the Contract Documents.

END OF SECTION 016000

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

1.2 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor’s List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner (sp). Label with manufacturer's name and model number.
5. Submit testing, adjusting, and balancing records.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.

7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

1.3 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

1.4 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction.

1.5 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Owner for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required. Note: 2 -CD-Roms required

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes. Note: 3 Final Bound Hard Copies Required

1. Binders: Heavy-duty, three-ring, vinyl-covered, post type binders, in thickness necessary to accommodate contents,; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

1.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include

manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1.5 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit two sets of marked-up record prints.

a. Initial Submittal:

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

1.3 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Note: provide electronic copy of record drawings on CD-Rom to owner.

1.4 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications. Note: provide electronic copy of record specifications on CD-Rom to owner.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

1.5 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's Owners reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within 7 days of end of each training module.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Pre-construction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.

f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of [an oral] [a written] [a demonstration] performance-based test.

F. Cleanup: Collect used and leftover educational materials and [remove from Project site] [give to Owner]. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera.

1. Submit video recordings on CD-Rom.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 020840-DISPOSAL OF ASBESTOS CONTAINING WASTE MATERIALS

UNION COLLEGE OF UNION COUNTY
FLOOR TILE & MASTIC ABATEMENT PROJECT

PART 1 - GENERAL

RELATED DOCUMENTS:
Section 01092 Codes and Regulations - Asbestos Abatement describes applicable federal, state and local regulations.

DESCRIPTION OF THE WORK:
This section describes the disposal of Asbestos-Containing Materials. Disposal includes packaging of asbestos-containing waste materials. Disposal may be accomplished by landfilling.

SUBMITTALS:

Before Start of Work: Submit the following to the Owner's Representative for review. The owners representative is RK Occupational and Environmental Analysis, 401 St. James Ave., Phillipsburg, NJ 08865. The contact at RK is Jonathan Gilbert, Project Manager, and the telephone number is 908-454-6316. **Email: rkenvironmental@entermail.net**. Do not start work until these submittals are returned with Owner's Representative's action stamp indicating that the submittal is returned for unrestricted use.

Copy of state or local license for waste hauler.

Name and address of landfill where asbestos-containing waste materials are to be buried. Include contact person and telephone number.

Chain of Custody form and form of waste manifest proposed.

Sample of disposal bag and any added labels to be used.

On a weekly basis submit copies of all manifests and disposal site receipts to Owner's Representative.

PART 2 - PRODUCTS:

Disposal Bags: Provide 6 mil thick leak-tight polyethylene bags labeled with three labels with text as follows: (NON MANDATORY)

First Label:

CAUTION
CONTAINS ASBESTOS FIBERS
AVOID OPENING OR BREAKING CONTAINER
BREATHING ASBESTOS IS HAZARDOUS TO YOUR HEALTH

020840-1

Second Label: Provide in accordance with 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING ASBESTOS FIBERS IS HAZARDOUS TO YOUR HEALTH

Third Label: Provide in accordance with U. S. Department of Transportation regulation on hazardous waste marking; 49 CFR parts 171 and 172; Hazardous Substances: Final Rule Published November 21, 1986 and revised February 17, 1987:

RQ HAZARDOUS
SUBSTANCE,
SOLID, NOS,
ORM-E, NA 9188
(ASBESTOS)

PART 3 - EXECUTION

Comply with the following sections during all phases of this work:

Section 01560: Worker Protection - Asbestos Abatement

The Contractor shall provide approved protective clothing to all workers, and to all official representatives of the Owner, State or other governmental entity, and the Consultant who may inspect the job site.

Protective clothing shall consist of full body coveralls, disposable headcovers, boots or sneakers and gloves as required by OSHA regulations. Eye protection and hard hats shall be available as appropriate. Coveralls may be of a paper disposable type.

The Contractor shall require that each person entering the Work Area shall wear an approved respirator and protective clothing. There shall be no exceptions to this rule.

Disposable protective clothing shall be disposed of as asbestos waste every time the wearer exits from the work space/equipment room to the shower room while proceeding to the clean area.

Section 01562: Respiratory Protection

The Contractor shall provide approved respirators to all workers and authorized representatives of the Owner, State or other governmental entity, and the Consultant who may inspect the job site.

The Contractor shall require that each person entering the work area shall wear an approved respirator. There shall be no exceptions to this rule.

Respiratory protection shall be in compliance with OSHA Regulations, 29 CFR 1910.1001, 1926.58, 1910.134, and ANSI Z88.2-1980. Respirators shall also be approved by NIOSH under 30 CFR Part II.

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At a minimum, respiratory protection shall be:

	.01-1.0 f/cc - Dual Cartridge, Air Purifying respirator with HEPA filters .	- Type A-
Non-mandatory:	1.0-10.0 f/cc - Powered Air Purifying Respirators (PAPR)	- Type B.
Non-mandatory:	10.0 f/cc-up - Type C supplied air with constant flow	- Type C.

All persons performing asbestos abatement work requiring respiratory protection (including Type B) shall be clean shaven and have an unobstructed face-mask seal.

GENERAL:
All waste is to be hauled by a waste hauler with all required licenses from all state and local authorities with jurisdiction.

Load all asbestos-containing waste material in disposal bags or leak-tight drums or double 6-mil lined sealed dumpster. All materials are to be contained in one of the following:

TWO 6 mil disposal bags, or

TWO 6 mil layers of poly sheets, or

Sealed steel drum with no bag, or

Secured waste container with a double 6 mil polyethylene sealable liner. Post asbestos warning labels directly on dumpster. Dumpster shall be locked.

Carefully load containerized waste in fully enclosed dumpsters, trucks or other appropriate vehicles for transport. Exercise care before and during transport, to insure that no unauthorized persons have access to the material.

Do not store containerized materials outside of the Work Area. Take containers from the Work Area directly to a sealed truck or dumpster.

Do not transport disposal bagged materials on open trucks. Label drums with same warning labels as bags. Uncontaminated drums may be reused. Treat drums that have been contaminated as asbestos-containing waste and dispose of in accordance with this specification.

Advise the landfill operator or processor, at least ten days in advance of transport, of the quantity of material to be delivered.

Unload containerized waste at disposal site.

At a disposal site, sealed plastic bags may be carefully unloaded from the truck. If bags are broken or damaged, return to work site for rebagging. Clean entire truck and contents using wet methods.

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At a processing site truck and loading dock are arranged as a controlled work area and containerized waste is transferred to storage area by site personnel. All bags including broken ones will be transferred. Clean truck using wetting techniques.

Retain receipts from landfill or processor for materials disposed.
At completion of hauling and disposal of each load submit copy of waste manifest, chain of custody form, and landfill receipt to Owner's Representative.

SPECIFIC REQUIREMENTS OF NJAC 5:23-8.22: ***(IF APPLICABLE)***

1. A notification of intent to remove and dispose of asbestos shall be sent to NJ DOL and NJ DOH AT LEAST 10 days in advance of actual disposal. The notification shall include the following:

   a. Name, address, and telephone number of the removal project;
   b. Quantity and nature of the waste to be disposed;
   c. Name, address, and NJ DEPE registration number of the collector/handler;
   d. Name and address of the landfill where disposal will occur;
   e. Date and time of disposal;
   f. A copy of any written notification required by 40 CFR 61.146 and 61.155.

2. All asbestos waste materials shall be wetted with a amended water and packaged in permanently sealed packaging which is leak-tight. The packing shall conform to the requirements listed previously. A locked, secure container shall be provided if asbestos waste is to be stored outside unattended.

3. Properly packaged asbestos waste is classified as Waste ID No. 27 and shall be disposed of as follows:

   a. The waste containers must be taken to a landfill registered by the NJ DEPE to accept ID No. 27 waste and must be designated as such by the NJ DEPE;

   b. The waste hauler must possess a valid solid waste transporter registration issued by NJ DEPE. The vehicle the hauler uses must be registered with NJDEPE;

   c. Asbestos waste can be hauled in trucks or in dumpster containers provided the load is comprised only of asbestos and does not contain any other wastes or asbestos-containing wastes which could compromise the integrity of the permanent containers;

   d. If rough surfaces or other materials are present in the load which could potentially puncture the permanent containers, then these containers shall be enclosed in temporary fiber or steel drums during

loading, transport, and unloading operations. Asbestos wastes shall not be loaded into or hauled with vehicles containing compaction devices.

END OF SECTION 020840

SECTION 024119

SELECTIVE DEMOLITION AND ALTERATION WORK

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the selective demolition and alteration work as shown on the drawings and/or specified herein, including but not limited to the following:

1. Alterations, selective demolition and removals as noted on drawings and as required to accommodate new construction.
2. Removal of debris.
3. Protection of existing building and spaces to remain.
4. Shoring of the structure as required for structural integrity and personal safety.
5. Protection of existing curbs and sidewalks.
6. Temporary coverage passageways.
7. Alterations, selective demolition and removals of exterior façade where noted.
8. Patching and refinishing of existing surfaces damaged as a result of this work.

1.3 QUALITY ASSURANCE

A. The Contractor shall comply with the requirements of all applicable Federal, State and local safety and health regulations regarding the demolition of structures including ANSI/NFPD 241-Building Construction and Demolition Operations.

B. The Contractor shall be responsible for any damage to any adjacent structures or buildings to remain.

C. Qualifications: Qualifications of Contractor for work of this Section shall not be less than ten (10) years of field experience in work of this nature.

D. Professional Engineering: The Contractor shall retain the services of a Professional Engineer licensed in the State of New Jersey, who shall design and supervise installation of all underpinning and shoring.

1.4 RELATED SECTIONS

A. Alteration and removal requirements for mechanical and electrical work - Mechanical and Electrical Sections.

1.5 SUBMITTALS

A. Schedule of Demolition Operations: Submit demolition procedures and operational sequence for Architect's review prior to start of work. Submit a written request to Architect well in advance of executing any cutting or alteration which affects:

1. The work of tying in or connecting to operational systems of the building, including electrical, mechanical and security systems.

2. The work of the Owner or any separate Contractor.

3. The structural value or integrity of any element of the project or of adjacent structures.

4. The integrity or effectiveness of weather-exposed and moisture-resistant elements or systems.

5. The efficiency, operational life, maintenance, or safety of operational elements or systems.

B. Notice of Differing Conditions: Submit a written notification if, during the work of demolition and cutting, conditions are discovered which significantly vary from those shown on the drawings. Do not commence work until approval of Architect.

C. Shop Drawings: Submit the following prior to starting work:

1. Submit for Architect's information shop drawings indicating location and typical construction details of temporary dustproof and weatherproof partitions.

2. Submit drawings of temporary structural shoring, bracing, framing or support, for the information of the Architect. Such drawings will be reviewed by the Structural Engineer for the effects of such temporary members on the structural elements to remain. These drawings shall include the reason for such temporary members, the location, the direction and magnitude of design reaction forces on existing structure, and details showing how these reaction forces will be applied to the existing structure.

a. Shop drawings shall be submitted with the Seal of the Professional Engineer engaged by Contractor; Professional Engineer must be licensed in the State of New Jersey.
b. The Architect will receive acknowledgment for concepts shown. Such acknowledgments shall be of the concept only and not of actual capacities or structural design and shall not in any way diminish or limit the Contractor's responsibility for the quality and performance of the work and for protecting existing structures and facilities.

1.6 SPECIAL PRECAUTION

A. Hazardous materials may be encountered during demolition operations including asbestos; comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.

1.7 JOB CONDITIONS

A. Condition of Structure

1. The Contractor for the work of this Section shall be held to have visited the site, examined the premises, determined for himself the existing conditions, character of equipment and facilities needed for the performance of the work, and all matters which may in any way affect the work before submitting a bid.

a. Information regarding existing construction or conditions is based on available record drawings which may or may not truly reflect existing conditions. Such information is included on the assumption that it may be of interest to the Contractor, but the Architect, Owner and their consultants do not assume responsibility for its accuracy or completeness.
b. Notify the Architect if, during the course of demolition, conditions are discovered which significantly vary from those shown on the drawings. Do not proceed until authorized by Architect.

2. The Contractor shall accept the condition of the site and structures as found. The Architect and Owner assume no responsibility for condition of site or structures nor the continuation of the condition existing at time of bidding or thereafter.

B. Areas of building to be demolished or altered will be vacated and discontinued in use prior to the start of the work.

1. Surrounding areas of the building shall remain operational by the Owner.

C. Partial Removal

1. Items of savable value to the Contractor may be removed from the structure as the work progresses. Salvaged items must be transported from the site as they are removed.

2. Storage or sale of removed items on the site will not be permitted.

D. Explosives: The use of explosives will not be permitted.

E. Traffic

1. Conduct demolition operations and the removal of debris to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities.

2. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

F. Utilities

1. Refer to Division 22 and 26 of the specifications for special requirements concerning utilities and services.

2. Maintain any existing utilities required to remain; keep in service and protect against damage during demolition operations.

3. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to the governing authorities.

4. Disconnect and seal any abandoned utilities before starting demolition operations. Coordinate all work with local utility companies having jurisdiction.

1.8 SCHEDULING

A. Before commencing any alteration or demolition work, submit for review by the Architect, and approval of the Owner, a schedule showing the commencement, the order, and the completion dates for the various parts of this work.

B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service to the structures to remain, notify the Architect and the Owner 7 days in advance and obtain the Owner's approval in writing before proceeding with this phase of the work.

PART 2 PRODUCTS

Refer to Part 3 - Execution, for Product Requirements

PART 3 EXECUTION

3.1 PROTECTION

A. Take full precautions to protect workmen, passersby, or any other persons from falling debris and other hazards of demolition operations.

B. Execute demolition work to insure protection of existing portions of building to remain against damages which might occur from falling debris or other cause. Do not interfere with use of adjacent occupied buildings and areas. Maintain free, safe passage to and from occupied adjacent buildings.

C. Materials Placement: Do not load structure with weight that will endanger, overload or cause excessive deflection of the existing structure, or that will damage finished surfaces adjacent to and/or supported by the existing structure, except portions being removed.

D. Construction Operations: Do not employ any construction operation, equipment or vehicles that will endanger, overload or cause excessive deflection of the existing structure, or that will damage finished surfaces adjacent to and/or supported by the existing structure, except portions being removed.

E. Take precautions to guard against movement, settlement, damage, or collapse of any part of building, sidewalks, adjacent property or street passages; be liable for any such movement, settlement or collapse. If such damage does accidentally occur, Contractor shall repair promptly at no cost to Owner.

F. Provide the necessary safeguards to prevent accidents, to avoid all necessary hazards and protect the public, the work and property at all times, including Saturdays, Sundays, and holidays.

G. Be responsible for any and all damages which may arise or occur to any party whatsoever by reason of the neglect in providing proper lights, guards, barriers, or any other safeguards to prevent damage to property, life and limb.

H. Make such explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. Give particular attention to shoring and bracing requirements so as to prevent any damage to existing construction.

1. Provide interior and exterior shoring, bracing, or support to prevent movement or settlement or collapse of structures to be demolished and adjacent facilities to remain. The Contractor's Professional Engineer shall advise on bracing, shoring, underpinning, or other structural requirements. The Contractor shall bear all responsibility for prevention of movement or other structural fault.

2. The Contractor shall restore, by repair or otherwise, the portions of structure or their contents altered by the Contractor in furtherance of his underpinning and support operations. Restoration shall be completed to the conditions which existed prior to the start of the work. Any damage caused by inadequate support shall also be restored by the Contractor at no cost to the Owner.

I. Provide, erect and maintain catch platforms, lights, barriers, weather protection, warning signs, and other items as required for proper protection of the workmen engaged in demolition and alteration operations, occupants of the building, public and adjacent property. Any damage caused by the Contractor's operations shall be promptly repaired by the Contractor at no cost to the Owner.

J. Provide and maintain temporary protection of the existing structure designated to remain where demolition, removal, and new work are being done, connections made, materials handled, or equipment moved.

K. Take necessary precautions to prevent dust and dirt from rising. Protect unaltered portions of the existing building affected by the operations under this Section by dustproof partitions and other adequate means.

L. Provide adequate fire protection in accordance with local Fire Department requirements.

M. Do not close or obstruct walkways, passageways, or stairways. Do not store or place materials in passageways, stairs, or other means of egress. Conduct operations with minimum traffic interference.

N. Be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.

O. Erect temporary covered passageways at street level as required by authorities having jurisdiction.

P. Promptly repair damages caused to adjacent facilities by demolition operations at no cost to the Owner.

Q. Provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.

3.2 INSPECTION

A. Verify that areas of demolition work are protected and temporary dustproof partitions have been installed.

B. Verify that construction to be removed is not load bearing or has been properly braced, framed or supported.

C. Inspect existing conditions of the project, including elements subject to damage or to movement during demolition and cutting.

D. After uncovering work, inspect the conditions affecting the installation or performance of the work.

1. Report differing or questionable conditions to the Architect in writing; do not proceed with the work until the Architect has provided further instructions.

3.3 PREPARATION

A. Provide adequate temporary support as necessary to assure the structural value or integrity of the affected portion of the work

B. Provide devices and methods to protect other portions of the project from damage.

C. Pollution Controls

1. Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.

a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

2. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition operations. Return adjacent areas to condition existing prior to the start of the work.

3. Provide drainage for temporary water use.

3.4 DEMOLITION AND CUTTING

A. Selectively demolish existing construction in conformance with the drawings and these specifications.

1. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surface to receive installation of work by others and patching of finish surfaces.

2. Do all cutting or removal so as to leave neat, true, plumb and square edges, at edges to remain. Use carborundum or diamond saw equipment for cutting masonry, concrete and stone work, where edges or surfaces are to remain.

3. Do not cut or remove construction which might weaken or impair the structural integrity or strength of the structural framing or support systems which are to remain.

4. Demolish and remove materials as shown on the drawings without damage to the remaining parts of the structure or mechanical/electrical/utility systems.

5. Remove materials so as to not impose excessive loads in supporting walls, floors or framing and so as not to damage remaining undemolished portions of the structure.

6. Where portions of structures are to be removed, remaining portions shall be protected from damage and prepared to fit new construction. Damage to portions of structures to remain shall be repaired.

7. Reinforcing steel in existing structures shall be left in place, cleaned and aligned to provide tie with new work.

8. Existing waterproofing systems and flashings shall be carefully exposed and protected to maintain workable conditions of fitting new work with existing construction.

9. Proceed with demolition in a systematic manner.

10. Demolish concrete and masonry in small sections.

11. Remove structural framing members and lower to ground by means of hoists, derricks, or other suitable methods.

B. Shoring

1. Design, provide, erect and maintain necessary temporary shoring, bracing, framing, or support where load bearing structural or supporting members are removed or weakened by cuts or openings or are subject to damage from demolition operations, and otherwise as required for safety or to protect finish surfaces from damage.

2. Construction and adequacy of the shoring shall be the entire responsibility of the Contractor. Any damage caused by the inadequacy of the shoring or other support shall be the responsibility of the Contractor to remedy at no additional expense to the Owner.

3. Shoring and bracing shall remain until new structural framing and/or supports are installed. Coordinate operations fully with other trades.

4. Be ready at any time to promptly provide, add to, or strengthen temporary shoring, bracing, or support for existing work, in case existing construction begins to show signs of structural stress.

3.5 WORKMANSHIP STANDARDS FOR ALTERATION AND REMOVAL WORK

A. Cut, remove, alter, temporarily remove and replace, or relocate existing work as required for performance of the work. Perform such work required with due care, including shoring and bracing.

B. Coordinate patching involving the various trades whether or not specifically mentioned in the respective specification Sections.

C. Materials or items demolished and not designated to become the property of the Owner or to be reinstalled shall become the property of the Contractor and shall be removed from the Owner's property.

D. Execute the work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the adjacent buildings.

E. In general, demolish masonry in small sections. Where necessary to prevent collapse of any construction, install temporary shores, struts, or bracing.

F. Materials to be removed by existing elevators shall be put in enclosed containers.

G. Where existing equipment and/or fixtures are indicated to be reused, repair such equipment and/or fixtures and refinish to put in perfect working order. Refinish as directed.

H. Cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.

I. Confine cutting of existing roof areas designated to remain to the limits required for the proper installation of the new work. Cut and fold back existing roofing. Cut and remove insulation and related items. Provide temporary weathertight protection as required until new roofing and flashings are installed. Consult the Owner to ascertain if existing guarantee bonds are in force and execute the work so as not to invalidate such bonds.

J. Where utilities are removed, relocated or abandoned, cap, valve, plug, or by-pass to make complete and working installation.

K. Restore existing pipe and duct coverings damaged by work under this Contract to original undamaged condition.

L. Immediately restore to service and repair any damage caused by Contractor's workmen to existing pipe and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems which are not scheduled for discontinuance or abandonment.

M. Upon completion of contract, deliver work complete. Damage that may be caused by Contractor or Contractor's workmen to existing structures designated to remain, grounds, and utilities shall be repaired by Contractor and left in as good condition as existed prior to damaging.

N. Restore finish work of floors, walls, and ceilings remaining in place but damaged or defaced because of demolition or alteration work to condition equal that which existed at beginning of work under this Contract.

O. Where alteration or removals expose damaged or unfinished surfaces or materials, refinish such surfaces or materials, or remove them and provide new or salvaged materials to make continuous surfaces uniform.

P. Perform new work and restore and refinish existing work in conformance with applicable requirements of the specifications, except as follows:

1. Materials for use in repair of existing surfaces, but not otherwise specified, shall conform to the highest standards of the trade involved, and be in accordance with approved industry standards, and shall be as required to match existing surfaces.

2. Workmanship for repair of existing materials shall, unless otherwise specified, be equal to similar workmanship existing in or adjacent to the space where the work is being done.

3. Installation of salvaged items where no similar items exist shall be done in accordance with the highest standards of the trade involved and in accordance with approved shop drawings.

Q. Materials or items designated to become the property of the Owner shall be as shown on the drawings. Remove such items with care and store them in a location at the site to be designated by the Owner.

R. Materials or items designated to be reinstalled shall be as shown on the drawings. Remove such items with care under the supervision of the trade responsible for reinstallation; protect and store until required. Replace materials or items damaged in their removal with similar new material.

S. The existing building shall not be used as a workshop, nor shall the furnishings or equipment in any room be used as work benches. Should any damage occur during the progress of the work to any furniture, fixtures, equipment, or appurtenances therein, such damage shall be repaired, replaced or made good by the Contractor without extra cost to the Owner.

T. Where removing existing floor finish and base, remove all adhesive and leave floors and walls smooth and flush, ready to receive new finish.

U. Finish new and adjacent existing surfaces as specified for new work. Clean existing surfaces of dirt, grease and loose paint before refinishing.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General

1. Remove from the site debris, rubbish and other materials resulting from work of this Section.

2. Burning of removed materials from demolished structures will not be permitted on the site.

B. Removal: Transport materials removed from demolished structures and legally dispose of off site. Pay any and all fees associated with disposal work. Leave the site in an orderly condition to the approval of the Architect.

3.7 CLEANING UP

A. Remove debris as the work progresses. Maintain existing premises in a neat and clean condition.

END OF SECTION

033000 CASTE-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

F. Samples: For water-stops, vapor retarder.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

B. Welding Certificates

C. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.

3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semi-rigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Field quality-control reports.

F. Minutes of pre-installation conference

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
   2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II
   3. Certification of recycled content shall be in accordance with the Sustainable Building Submittal Requirements of this section.
   4. Adhesives or sealants used for work in this section shall meet the VOC requirements of this section, where applicable.
   5. Recycled Steel: Reinforcing bar, steel wire, welded wire fabric, and miscellaneous steel accessories shall contain a minimum of 35% (combined) pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials).

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7, “Lightweight Concrete.”
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Pre-installation Conference: Conduct conference at Project site or another pre-approved location.
   1. Review the proposed concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor / finishing foreman.
      e. Special concrete finish subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.7 MEASUREMENTS

A. Field Measurements: Obtain all field measurements required for proper fabrication and installation of work. Submit prior to installation, all measurements indicating discrepancies from the drawings. Describe in writing, and where applicable, by sketches proposed methods of correcting the discrepancies. Measurements are the responsibility of the contractor.

B. Lay out each part of the work in strict accordance with the architectural, structural, mechanical, electrical, plumbing and all other drawings and be responsible for correct location of the same. Lay out from at least two pre-established benchmarks and axis lines, individually correct for length and bearing.

C. Templates: Furnish templates and layout drawings for exact locations of items to be embedded in concrete, with setting instructions required for installation of embedded items.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive damp-proofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 35 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.

E. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

F. Deformed-Steel Wire: ASTM A 496/A 496M.

G. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

H. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class F or C
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C 330, 3/4 inch (19mm) nominal maximum aggregate size.

E. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260. Subject to compliance with requirements, provide one of the following:
1. Air Mix 200 or AEA 92S; Euclid Chemical Company

2. Darex AEA; W.R. Grace
3. MasterAir VR 10; BASF

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A. Provide one of the following:
   a. Eucon WR-91; Euclid Chemical Company
   b. MasterPolyheed 997; BASF
   c. WRDA 64; W.R. Grace
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D. Provide one of the following:
   a. Eucon Retarder 75; Euclid Chemical Company
   b. MasterSet R 100; BASF
   c. Daratard; W.R. Grace
   d. Plastiment; Sika Corp.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F. Provide one of the following:
   a. Eucon 37, Plastol Series or SPC; Euclid Chemical Company
   b. MasterRheobuild 1000 or MasterGlenium 7500; BASF
   c. Daracem-100; W.R. Grace
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G. Provide one of the following:
   a. MasterGlenium Series; BASF
   b. Eucon 537; Euclid Chemical Company
   c. ViscoCrete Series; Sika Corp.

2.6 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Monofilament or fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Monofilament Micro-Fibers:
      1) Axim Italcementi Group, Inc.; Fibrasol II P.
      2) Euclid Chemical Company (The); Fiberstrand 100.
      3) Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
      4) Sika Corporation; Sika Fiber PPM.
   b. Fibrillated Micro-Fibers:
      1) Axim Italcementi Group, Inc.; Fibrasol F.
      2) Euclid Chemical Company (The); Fiberstrand F.
      3) Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
      4) Sika Corporation; Sika Fiber PPF.

B. Synthetic Macro-Fiber: Synthetic (Polyolefin) Macro fibers shall be a coarse monofilament, self-fibrillating, polypropylene/polyethylene to blend in accordance with ASTM C1116, Paragraph 4.1.3, Type III and ASTM D7508. Synthetic macro-fiber shall be a minimum 1-1/2 inch (38mm) length, a minimum aspect ratio of 50-90, and shall provide a minimum tensile strength of 70 KSI (483 MPa). Synthetic macro-fiber shall be UL-certified for 2-hour minimum fire-resistance-rated construction

when used in lieu of welded wire fabric in UL Design Series D700, D800, and D900 Floor-Ceiling Assemblies.

1. Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4.0 lb/cu. yd. (2.4 kg/cu. m) for suspended slabs over metal decks in accordance with Steel Deck Institute Manual 31.
2. Submit fiber manufacturer's documentation indicating that proposed fiber dosage will provide a minimum Re3 (R^{D}_{T150}) value of <insert value> percent in accordance with ASTM C 1609.
3. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 3.0 lb/cu. yd. (1.78 kg/cu. m) for concrete slabs on ground.
    a. Tuf-Strand SF; Euclid Chemical Company
    b. Strux 90/40; GCP Applied Technologies

2.7 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
        a. BoMetals, Inc.
        b. Greenstreak.
        c. Paul Murphy Plastics Company.
        d. Vinylex Corp.
    2. Profile: Ribbed with center bulb
    3. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick) nontapered.

B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
    1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
        b. CETCO; Volclay Waterstop-RX.
        c. Concrete Sealants Inc.; Conseal CS-231.
        d. Greenstreak; Swellstop.

2.8 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
    1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
        b. Meadows, W. R., Inc.; Perminator 15 mil.
        c. Raven Industries Inc.; Vapor Block 15.
        d. Reef Industries, Inc.; Griffolyn Type-65G.

2.9 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid/Sealer Densifier (VOC Compliant): Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. The compound must contain a minimum solids content of 20%, of which 50% is siliconate.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
   b. L&M Construction Chemicals, Inc.; Seal Hard.
   c. Meadows, W. R., Inc.; LIQUI-HARD.
2. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for sealants applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   a. Primers, Sealers, and Undercoaters: 200 g/L.
   b. Waterproofing Concrete/Masonry Sealers: 400 g/L.
   c. Concrete-Curing Compounds: 100 g/L.
   d. Floor Coatings: 100 g/L.

2.10 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound (VOC Compliant): ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
   b. BASF Construction Chemicals - Building Systems; Kure 200.
   c. Euclid Chemical Company (The); Kurez DR VOX OR Everclear VOX.
   d. L&M Construction Chemicals, Inc.; L&M Cure R.
   e. Meadows, W. R., Inc.; 1100-CLEAR.
2. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for sealants applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   a. Primers, Sealers, and Undercoaters: 200 g/L.
   b. Waterproofing Concrete/Masonry Sealers: 400 g/L.
   c. Concrete-Curing Compounds: 100 g/L.
   d. Floor Coatings: 100 g/L.
3. Provide one of the following:
   a. Dural 452 Series; The Euclid Chemical Company
   b. Sikadur 32 Hi-Mod Series; Sika Corp.

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Epoxy Bonding Adhesive (VOC Compliant): ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
   2. VOC Content: Epoxy Bonding Adhesive shall have a VOC content of 70 g/L or less.

C. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
   5. Products: Subject to compliance with requirements, provide one of the following or equal approved by Engineer of Record:
      a. Flo-Top, Super Flo-Top or EucoFloor SL160; Euclid Chemical Company
      b. MasterTop 111 SL; BASF

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 4000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.
   5. Products: Subject to compliance with requirements, provide one of the following (or equal) approved by the Engineer of Record:
      a. Thin Top Supreme, Tammspatch II or Concrete Top Supreme; Euclid Chemical Company

b. Sikatop 121 or Sikatop 122; Sika Corp.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use high water-reducing admixture in pumped concrete, architectural concrete for heavy-use industrial slabs and parking structure slabs, self-consolidating concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
   4. Use a non-corrosive accelerator in all concrete less than 8 inches in thickness, placed at temperatures below 50 degrees Fahrenheit. Do not use calcium chloride, salts or other admixtures containing more than 0.5% chloride ions by weight.
   5. Use corrosion inhibiting admixture in concrete mixtures where indicated. The dosage shall be 3-5 gallons/cy unless otherwise noted on the plans.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings & Foundation Walls: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.50.
   3. Slump Limit: 9 inches (225 mm) for concrete with verified waterslump of 2 to 3 inches (50 to 75 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
   4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.50.
   3. Minimum Cementitious Materials Content: 540 lb/cu. yd. (320 kg/cu. m).
   4. Slump Limit: 6 inches (150 mm).
   5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

C. Suspended Slabs: Proportion lightweight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
   2. Calculated Equilibrium Unit Weight: 115 lb/cu. ft. plus or minus 3 lb/cu. ft. as determined by ASTM C 567.

3. Slump Limit: 6 inches (150 mm), plus or minus 1 inch (25mm).
4. Air Content: 4.5% to 6%

2.15 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
   2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Do not chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
   3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 80 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
   1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   5. Locoate vertical joints in walls beside piers integral with walls, near corners, and in concealed locations where possible.
   6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting

action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
   2. The Concrete Producer shall provide a re-dsosage chart for the high range water reducing admixture. Re-dosage onsite may be required to keep the concrete in the approved slump or spread envelope.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
4. Freeze resistant concrete may be used with prior approval of the Engineer of Record.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete or as indicated.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

E. Architectural Concrete Finish: Provide smooth, uniform finish upon form removal with no patching, stoning or other form of repair, except washing, permitted unless otherwise noted for walls, columns and other surfaces visible to view when the work is complete. Use self-consolidating concrete. The surface shall match the approved jobsite mockup panel.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
   1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated or to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
      a. Specified overall values of flatness, F(F) 35; and levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and levelness, F(L) 17; for slabs-on-grade.
      b. Specified overall values of flatness, F(F) 30; and levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and levelness, F(L) 15; for suspended slabs.
   3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch (4.8 mm).

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a strippable or dissipating curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing and Sealing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Interior slabs to receive resilient flooring: Cure only with moisture retaining cover. Strippable or dissipating curing compounds may be used on trowel finished surfaces.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 14 days' old.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least 6 month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
   3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
   1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   2. After concrete has cured at least 14 days, correct high areas by grinding.
   3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
   4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
   5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
   7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.
   3. Headed bolts and studs.
   4. Verification of use of required design mixture.
   5. Concrete placement, including conveying and depositing.
   6. Curing procedures and maintenance of curing temperature.
   7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173 M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Water Content and W/cm: In accordance with AASHTO T318 (Microwave Test).
   5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
   6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day’s pour of each concrete mixture.
   7. Compression Test Specimens: ASTM C 31/C 31M.
      a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
      b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
   8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
      a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
      b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
   9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
   10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and

no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

11. Monthly charts of compressive strength, w/cm and air content will be sent to all parties on the pre-concrete conference distribution list.
12. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
13. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
14. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
15. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
16. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement
7. Aggregates.
8. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

    b. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.

9. Color pigments.
10. Curing materials.

    a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

11. Joint fillers.

12. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Steel-fiber reinforcement content.
10. Synthetic micro-fiber content.
11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
14. Intended placement method.
15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

a. Location of construction joints is subject to approval of the Engineer.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement.
7. Aggregates.
8. Admixtures:

    a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality-Control Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.
f. Permeability.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I Type II,.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.

8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.3 CURING MATERIALS

A. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ChemMasters, Inc.
b. Concrete Sealers USA.
c. Kaufman Products, Inc.

2.4 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. Types I and II, nonload bearing Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.5 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.6 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Silica Fume: 10 percent by mass.

4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
4. Use permeability-reducing admixture in concrete mixtures where indicated.

D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.7 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.
1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum w/cm: .48
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content:

a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

B. Class B: Normal-weight concrete used for foundation walls.
1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum w/cm: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content:

a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 TOLERANCES

A. Comply with ACI 117.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.5 INSTALLATION OF CAST-IN-PLACE CONCRETE

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

3.6 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Engineer.

2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.

4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.8 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

    a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    b. Remove projections larger than 1 inch.
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 Class D.
    e. Apply to concrete surfaces not exposed to public view.

2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class B.
    e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish.

3. ACI 301 Surface Finish SF-3.0:

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/8 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class A.
    e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finish: Apply the following to as cast surface finishes wherever these type of surfaces are shown on the Drawings:

1. Smooth-Rubbed Finish:

    a. Perform no later than one day after form removal.
    b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
    c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
    d. Maintain required patterns or variances as shown on Drawings.

2. Grout-Cleaned Rubbed Finish:

    a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
    b. Do not clean concrete surfaces as Work progresses.
    c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
    d. Wet concrete surfaces.
    e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
    f. Maintain required patterns or variances as shown on Drawings.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
3. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

    a. Slabs on Ground:

        1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch and also no more than 1/16 inch in 2 feet.
        2) Specified overall values of flatness, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 17; and of levelness, F_L 15.
        3) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.
        4) Specified overall values of flatness, F_F 45; and of levelness, F_L 35; with minimum local values of flatness, F_F 30; and of levelness, F_L 24.
        5) Specified overall values of flatness, F_F 50; and of levelness, F_L 25; with minimum local values of flatness, F_F 40; and of levelness, F_L 17.

    b. Suspended Slabs:

        1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
        2) Specified overall values of flatness, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 17; and of levelness, F_L 15.
        3) Specified overall values of flatness, F_F 35; and of levelness, F_L 20; with minimum local values of flatness, F_F 24; and of levelness, F_L 15.
        4) Specified overall values of flatness, F_F 45; and of levelness, F_L 35; with minimum local values of flatness, F_F 30; and of levelness, F_L 24.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings and/or where ceramic or quarry tile is to be installed by either thickset or thin set method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Engineer before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

2. Coordinate required final finish with Engineer before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings

1. Apply in accordance with manufacturer's written instructions and as follows:

a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
b. Tamp aggregate flush with surface, but do not force below surface.
c. After broadcasting and tamping, apply float finish.
d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
4. After final floating, apply a trowel finish.
5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.10 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.11 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

    a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

        2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.

        3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

            a) Water.
            b) Continuous water-fog spray.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
    1. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Engineer.
2. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

    a. Limit cut depth to 3/4 inch.
    b. Make edges of cuts perpendicular to concrete surface.
    c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    d. Fill and compact with patching mortar before bonding agent has dried.
    e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

    a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

    a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

   a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
   b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

   a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
   b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
   c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
   d. Place, compact, and finish to blend with adjacent finished concrete.
   e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

   a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
   b. Dampen cleaned concrete surfaces and apply bonding agent.
   c. Place patching mortar before bonding agent has dried.
   d. Compact patching mortar and finish to match adjacent concrete.
   e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. The scheduling and costs for all testing shall be the responsibility of the contractor.
   1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
   2. Testing agency to immediately report to Engineer, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
   3. Testing agency to report results of tests and inspections, in writing, to Owner, Engineer, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests when concrete consistency appears to change.

3. Slump Flow: ASTM C1611/C1611M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
    b. Cast, initial cure, and field cure two sets of three standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
    b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
    c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:

a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.

1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Engineer.

3.15 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

PART 4 - MEASUREMENT, QUANTITY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all excavation, shoring, formwork, finishes, steel reinforcement, reinforcement accessories, concrete materials, admixtures, water stops, vapor barriers, treatments, curing materials, joint fillers, bonding agents, adhesives, repair materials, testing, and all related appurtenances as required per the contract documents.

END OF SECTION 033000

SECTION 03-4110 - PRECAST / PRESTRESSED INSULATED WALL PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the precast/prestressed insulated wall panels as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Pre-cast insulated concrete panels with exposed architectural concrete finishes.
2. Provide anchorages, reinforcing bars, welded wire steel fabric, ties, supports and anchorages required for reinforcement of pre-cast concrete units.
3. Provide all structural steel inserts, lifting hooks, anchor units, plates, dowels, etc., cast in to precast concrete members required for handling and for the connections of pre-cast members, and all loose structural steel anchor units, angles, plates, etc., required to connect pre-cast units to the structural framework of the building.
4. Provide all structural steel anchor units, angles, plates, bearing pads, shims, bolting, welding, grouting, dry packing and all other materials and accessories necessary for the setting, connection and accurate placement of the pre-cast concrete units to structures. Furnish complete layout details for the installation of the above.
5. Cast in to the pre-cast units all inserts, anchors, blocking, sleeves, and housing for the attachment of electrical and plumbing equipment to the pre-cast concrete.
6. Check all lines, levels, planes and pitches required for accurate placement of work of this Section.
7. Protect, repair, patch and clean all pre-cast concrete work of this Section, as required.
8. Provide full time supervision of the erection and installation of pre-cast concrete work.
9. Furnish all mock-up work, samples, design mixes and laboratory tests required in connection with work under this Section.
10. Prepare the engineering design calculations for all architectural pre-cast concrete members and connections, and prepare required shop, erection and setting drawings and details for work under this Section.

1.2 RELATED DOCUMENTS:

A. Cast in place concrete – Section 033000

B. Architectural Precast Concrete – Section 034500

C. Unit Masonry – Section 042000

D. Miscellaneous Metals – Section 055000

E. Water repellant coating – Section 07190

F. Building insulation – Section 072100

G. Sheet Metal Work – Section 076200

H. Joint Sealants – Section 079200

I. Expansion Control 079500

1.3 REGULATIONS AND REFERENCE STANDARDS

A. All work shall be done according to the following codes and reference standards unless specifically shown or specified otherwise in Contract Documents:

1. Local Building Code.
2. ACI 318: "Building Code Requirements for Reinforced Concrete."
3. ACI 315: "Manual of Standard Practice for Detailed Reinforced Concrete Structures."
4. ACI 306: "Cold Weather Concreting."
5. ACI 305: "Hot Weather Concreting."
6. ACI 211.1: "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete."
7. ACI 304-73: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
8. ACI 347: "Recommended Practice for Concrete Formwork."
9. PCI MNL-117: "Manual for Quality Control for Plants and Production of Architectural Pre-Cast Concrete Products."
10. PCI Design Handbook, Pre-Cast and Pre-Stressed Concrete.
11. AISC Manual of Steel Construction, Latest Edition.
12. AWS D1.1 - Rev. 2: "Structural Welding Code."
13. AWS D12.1: "Reinforcing Steel Welding Code."
14. Applicable ASTM Specification.
15. Industrial Fasteners Institute, Handbook for Fastener Standards.

B. The Contractor shall have available at all times for reference the above regulations, standards, etc., editions noted (or the latest edition, if edition is not noted).

C. Where reference is made to Specifications of American Society for Testing Materials (ASTM) or other specific standards, furnish material and/or work in strict accordance with referenced standard, subject to any qualifications herein.

D. In the event of discrepancies between various regulations and standards referred to above, most stringent requirements govern.

1.4 DESIGN

A. Design of the precast work shall be in accordance with the following:

1. ACI 318

2. IBC

3. PCI Design Handbook.

1.5 REJECTIONS

A. Defective Work

1. Precast concrete units which do not conform to the specified requirements, including dimensional tolerances, strength, and finishes, shall be repaired or replaced with pre-cast concrete units that meet the requirements of this Section. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the pre-cast concrete work.

2. Defective pre-cast concrete units and materials that do not comply may be rejected at any time, whether in place or not. Promptly repair to satisfaction of Architect or remove and replace rejected pre-cast concrete units and materials at no additional cost to the Owner.

B. Dimensional Tolerances

1. Units having any dimension smaller or greater than required, and outside the specified PCI tolerance limits, will be considered deficient and shall be rejected if the appearance or function of the unit is adversely affected, or if the larger dimensions interfere with other construction. Repair, or remove and replace, rejected units as required to meet the construction conditions.

C. Strength Deficiencies

1. When there is evidence that the strength of a pre-cast concrete unit does not meet specification requirements determined by Precast Engineer, the Owner's Testing Laboratory, upon direction from the Architect, and with the Owner's written approval, shall take cores drilled from hardened concrete or perform non-destructive strength tests to determine compressive strength.

2. Determination of compressive strength by drilled cores shall comply with ASTM C42 and as follows:

a. Take at least three (3) representative cores from pre-cast units of suspect strength, from locations directed by the Architect.

b. Test cores in a saturated surface dry condition per ACI 318 if the concrete will be wet during the use of the completed structure.

c. Test cores in an air dry condition per ACI 318 if the concrete will be dry at all times during use of the completed structure.

d. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least eighty-five (85) percent of the twenty-eight (28) day design compressive strength.

e. Test results will be made in writing on the same day that tests are made, with copies to the Architect and Contractor. Include in test reports the project identification name and number, date, name of pre-cast concrete manufacturer, name of concrete testing service, identification letter, number, and type of member or members represented by core tests, nominal maximum size aggregate, design compressive strength, compression breaking strength and type of break (corrected for length diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moistened condition of core at time of testing.

3. Patching: Where core test results are satisfactory and pre-cast units are acceptable for use in the work, fill core holes solid with patching mortar, and finish to match adjacent concrete surfaces.

D. Finishes: Architectural pre-cast concrete units whose finish has any of the following defects will be rejected. Repair the following finish defects if permitted by the Architect, or remove and replace rejected units as required to meet the requirements of this Section.

1. Does not match previously approved samples as to uniformity of color or texture.

2. Has chipped, ragged, irregular or broken corners or edges.

3. Joints, false joints, drips or notches are not properly located or aligned.

4. Has damaged surfaces, notches or other surface defects.

5. Excessive air pits and voids evident on the exposed surfaces.

6. Adjacent flat and return surfaces with more than a slight difference in exposure.

7. Casting lines evident from different placements.

8. Visible form joints or irregular surfaces.

9. Rust staining on panel surfaces.

10. Blotching or acid stains evident on panel surfaces.

11. Foreign material embedded in the facing mix.

12. Cracks visible after wetting.

13. Visible repairs.

14. Reinforcement shadow lines.

1.6 QUALIFICATIONS

A. The work of this Subcontract shall be executed only by a Company with 5 years proven experience in the design and manufacture of precast/prestressed insulated wall panel components, and having adequate finances, equipment, plant and skilled personnel to expeditiously detail, fabricate and install the work of this section as required by the Drawings and Specifications.

B. The manufacturer shall be responsible for the design, connections and installation of the precast concrete units and shall provide placing details for all items to be cast in poured concrete, or attached to structural walls and framing provided by others.

C. Production and erection drawings and design calculations shall be the responsibility of a registered Professional Engineer. Design calculations shall be sealed by the Engineer.

D. The Manufacturer shall be qualified as a producer/member of the P.C.I. Plant Certification Program prior to the time of bid. It is recommended that the producer be a member of PCI for a minimum of 5 years.

1.7 SAMPLES

A. Provide 12" x 12" samples of each finish as required by the Architect for his approval. Upon approval of samples for finish and color, the Architect will inspect a large size mock-up panel (with insulation) at the manufacturer's plant prior to scheduled production. The mock-up panel should represent the finished product with respect to details such as returns, edge conditions, repairs and finished lift point patching or plastic caps. Upon approval of the mock-up panels, they shall become the recognized standard for production run panels.

1.8 SHOP DRAWINGS

A. Shop Drawings: Prepare shop drawings, details and schedules as required to fully illustrate details of work and to meet job conditions. Provide separate shop drawings for mock-up work. The shop drawings shall include, but are not limited to, the following:

1. Location of each identified pre-cast concrete unit in the completed structure. Show all openings and all dimensions. Show relationship to structural framing members. Show concrete types, strengths and finishes.

2. Show reinforcing details, including grade, type and size of reinforcing bars, welded wire fabric.

3. Details of Connections: Show joints, bearings, connection devices, length and types of welds, all related embedded items and grouting and dry packing.

4. Show jointing clearances and clearances between the units.

5. Show full size typical details of joints between units, showing methods of sealant installation, coordinated with sealant contractor.

6. Prepare shop drawings in accordance with "Manual of Standard Practice for Detailing Reinforced Concrete Structures" (ACI-315), except where in conflict with local building regulations. Scale of details shall be adequate to fully and clearly illustrate work.

7. Submit complete design calculations for all pre-cast members and connections. Indicate all design loads, including live loads, wind loads, seismic loads, and dead loads and including all stresses during shipment and erection and due to loads from construction procedures. Design calculations shall be done by Pre-Cast Concrete Contractor's Professional Engineer, licensed to practice in the State of Pennsylvania. Calculations shall be submitted a minimum of four (4) weeks prior to scheduled start of fabrication. Design calculations shall be based on the design requirements specified herein.

   a. Panels and connections shall be designed for their gravity loads.

   b. Panels and connections shall be designed for lateral wind load pressures as follows:

      1). Typical Panels: As per Code.

   c. Connections of panels to structural supporting members shall be made so as to not induce eccentric or torsional forces in the supporting members.

B. Erection drawings shall include:

1. Location of each unit in the completed structure.

2. All dimensions of each unit, including locations of connections between precast and other work.

3. Jointing clearances and clearances between units and the structural building framework.

4. Complete connection and insert details including materials, size and length of welds.

5. Class of finish and location of each precast item.

6. Identifying mark number for each precast product.

7. Any special handling instructions or bracing required.

8. Special precautions to be taken by other trades affecting the work of this subcontract.

1.9 MOCKUPS

A. Mock-Up: Prior to the approval for fabrication of any pre-cast work, but after the approval of the full size samples, display a mock-up of the panel at the fabricator's plant.

1.10 INSPECTION AND TESTING

A. Inspection and testing of precast and prestressed concrete may be carried out by an independent Inspection and Testing Company appointed and paid for by the Owner, except for the testing requirements listed below. If inspection discloses improper workmanship or inferior material, subsequent inspection or test on that issue deemed necessary by the Architect shall be at no cost to the

Owner. The precast manufacturer may perform the necessary inspection and testing of the precast components if the facility is a PCI Certified Plant.

B. Cooperate with the Inspection and Testing Company and provide access to all materials used in the concrete.

C. The following inspection must be carried out at the plant:

1. Forms.
2. Size and location of reinforcing.
3. Size and location of cast-in hardware.
4. Mill test reports.
5. Concrete batching methods.
6. Cylinder compression tests.
7. Curing Methods.
8. Slump tests.
9. Air tests.
10. Size of completed units.
11. Finishes.

D. The Owner's Inspection Company shall immediately report results of tests and inspections directly to Architect who will issue copies to the Contractor and the Precast Concrete Manufacturer.

1.11 HANDLING, STORAGE AND PROTECTION

A. Design lifting devices to ensure that precast panels will be safely and efficiently handled at all times. Cast-in lifting devices shall be arranged in non-exposed areas of the precast panels where possible. Lifting devices located in exposed areas that receive an architectural finish are to be patched with grout and concrete to match surrounding finish.

B. Stack units on properly cushioned supports to protect the edges from spalling.

C. Do not permit units to contact earth or other staining influences, or to rest on corners.

D. Protect all holes and reglets against water and ice in freezing weather.

E. Take required precautions to protect installed precast work while erection is in progress.

1.12 GUARANTEE

A. Provide the Owner with the following guarantee in writing: "We (name of Manufacturer or Subcontractor) do, hereby, guarantee that the precast units will not spall or show evidence of visible

cracking beyond accepted industry standards, splitting, deformation, or loosening resulting from inferior materials or workmanship by this trade for a period of one (1) year effective from the date of the substantial completion of the precast erection. Precast units showing such defects will be repaired or replaced and made acceptable at no expense to the Owner."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer as basis of design or approved equal

B. High Concrete Group LLC, 125 Denver Road, Denver, PA 17517. Contact Alexandra Clayton 717-538-8078.

C. Substitutions: as per Section 01-2500.

2.2 MATERIALS

A. Cement Type:

1. Portland Cement, ASTM C 150, Type I or Type III (White and/or Gray) to match control sample.

2. Eco-Mix Blended Portland Cement containing Supplementary Cementitious Materials (SCMs) not to exceed 40% comprising one of more of the following

a. Ground Blast Furnace Slag, ASTM C989.

b. Silica Fume, ASTM C1240.

c. Fly Ash, ASTM C618.

B. Aggregates:

1. Shall conform to applicable section of ASTM C33. Provide aggregates from a single source for architecturally finished concrete. Local aggregates not complying with ASTM C 33, but which have shown by special test or actual service to produce concrete of adequate strength and durability, may be used when acceptable to the Architect. Aggregate materials to match Owner's control sample.

2. Concrete shall have a minimum compressive strength at 28 days of 5,000 PSI (max. .40 w/c ratio)

C. Admixtures:

1. Air-entrained admixture shall be 5% (+ or -) 1.5%.

2. Water reducing admixtures should be used in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low slump concrete, may be used subject to Architect's acceptance. Use amounts as recommended by

admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.

3. The use of self-consolidating concrete is permitted provided that mix design proportions and constituents meet the requirements of this specification.

D. Reinforcing Steel:

1. Billet steel bars conforming to ASTM A 615, Grade 60K.

2. Low alloy steel reinforcing should conform to ASTM A 706, Grade 60K.

3. Reinforcing larger than 1/4" diameter shall be deformed bars conforming to the same standard as (a) above.

4. Welded wire mesh shall conform to ASTM A 185, Grade 60K.

5. Prestressing strand shall be uncoated seven (7) wire low relaxation strand ASTM A416, Grade 270K.

E. Anchors and inserts:

1. Materials:

a. Structural Steel shall be of new material conforming to ASTM A 36.

b. Bolts: A325 or A307

c. Welded headed studs: AWS D1.1-Type B.

d. Deformed bar anchors: ASTM A496.

2. Finish:

a. Hot dipped galvanized: ASTM A153.

b. Zinc Rich Coating: Self curing, one component, "Galv-a-kote" 13F22 gray, standard brushing grade. For touch up only.

c. Cadmium plated: ASTM A165.

F. Insulation:

1. Molded polystyrene as defined by ASTM C-578.

G. C-GRID® Carbon fiber wythe connectors (basis of design):

1. The wythe shear transfer connectors (connecting the inner concrete wythe to the outer concrete wythe) shall be a resin-bonded, epoxy coated, non-corrosive, low conductive composite grid consisting of cross-laid carbon fibers.

H. Forms:

1. To be constructed of approved concrete, steel, wood or fiberglass reinforced plastic or high density overlaid plywood to obtain the quality of the finish specified.

I. Grout:

1. Cement Grout: Portland cement, ASTM C150, Type I and Clean; natural sand, ASTM C404. Mix at ratio of 1.0 part cement to 3 parts sand, by volume, with minimum water required for placement and hydration.

2. Non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C621.

3. Available products--Available products subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. Euco N.S., Euclid Chemical Company

b. Masterflow 713, Master Builders

c. Five Star Grout, U.S. Grout Corporation

d. B/C Non-shrink Grout, Admixtures, Inc.

e. SikaGrout Non-shrink Grout, SIKA Corporation

2.3 FINISHES

A. The interior face of insulated wall panels to receive a painted finish are to have an as-cast form finish ready for painting. Small blemishes and form joint lines will be acceptable in the panel surface, but no major unsightly imperfections will be allowed.

B. Exterior precast elements required to have an architectural finish shall receive a sandblasted finish as required by the Architect's control sample.

2.4 FIELD DIMENSIONS

A. Perform a field pre-erection survey prior to erection of precast concrete wall panels. Report any discrepancies to the contractor as soon as they are discovered for correction prior to start of precast erection.

2.5 FABRICATION

A. Precast concrete exposed surface finish shall match approved samples.

B. Fabricate units to profiles and sizes detailed in accordance with approved shop drawings.

C. Execute work accurately, true to dimensions, square, free from cracks, broken edges or warped conditions.

D. Quality of concrete, placing materials in forms, vibrating, curing, stripping and handling shall be within accordance with PCI-MNL 116 & PCI-MNL-117, and this standard shall apply to all precast units required under this contract. For prestressed units, minimum release strength shall be 2,500 PSI.

E. Fabricate precast work within dimensional tolerances in compliance with PCI-MNL-117.

F. Cast-in lifting devices required for erection of precast concrete work. Manufacturer shall ensure that all lifting devices used externally or embedded are capable of supporting precast concrete work in all attitudes occurring during course of manufacturing, yard handling and installation.

G. The Architect shall visit the plant to inspect proposed methods of control of mix, fabrication, curing practices and approve first run production units no later than five days after precast manufacturer's request.

H. Manufacture units in molds made of steel, or wood, designed to withstand vibration and lateral forces.

I. Identify all precast units with a number on an unexposed edge identifying the panels with information on the cast date, mark number for coordination with precast shop drawings, and orientation of unit in final position.

J. Curing should be performed in accordance with PCI recommended practices such that the strength and finish of the unit is not impaired.

K. The precast manufacturer shall provide for those openings 12" round/square or larger as shown on the contract drawings. Other openings shall be located and field drilled [or cut] by the trade requiring them after the precast, prestressed concrete products have been installed. Locations of field cut openings shall be reviewed and approved by the precast manufacturer prior to any field coring or cutting of the precast/prestressed panels.

2.6 WELDING

A. Perform welding in accordance with AWS D12.1 Reinforcing Steel Welding Code, and AWS D1.1 Structural Welding Code.

B. Provide fit up plates or angles to compensate for deviations, alignment or location of inserts.

C. Exercise care to minimize effect of welding heat. Design welds to prevent tearing at end of weld, which would cause progressive failure.

PART 3 - EXECUTION

3.1 ERECTION EQUIPMENT AND SAFETY REGULATIONS

A. The precast concrete subcontractor shall be responsible for a safe erection and comply with applicable safety requirements of the Owner's site, as well as all local and state safety regulations.

B. Secure each unit safely and adequately in position by positive mechanical connections.

C. Use sufficient temporary bracing to brace work adequately, if required.

D. Use erection equipment that is not bent, twisted, warped or damaged in any way. All wire ropes for cranes or lifting bars shall be of full sections -- not bent, twisted, kinked, torn or stretched. Clearly mark the design capacity of all lifting beams, platforms and trusses for a safe erection operation.

3.2 SITE ACCESS

A. General Contractor shall be responsible for providing unobstructed, suitable access within the building site as required for erection of the precast. The general contractor is responsible to provide a firm, level area of access so the hauling and erection equipment can move under its own power to the point of erection.

B. General Contractor shall make provisions as required for placement and accurate alignment of anchor bolts, plates or dowels in column footings, grade beams and other field installed supporting members.

3.3 INSTALLATION

A. Execute this work with workmen skilled in this trade, set work plumb, true and square with joints parallel and uniform, all in accordance with the approved erection drawings. Accurately place all shims and bearing pads.

B. Install precast concrete units in conformance with the tolerances listed in PCI-MNL-127.

C. Anchor units in final position by bolting and/or welding as shown on drawings. All field welding must be done by certified welders in accordance with AWS D12.1. Complete grouting of bearing points as required.

3.4 REJECTION OF WORK

A. Any precast wall panels containing concrete which has failed to meet strength requirements determined by the Precast Engineer shall be cored as directed by the Architect. Unit may be rejected at the Architect's discretion only after the core test confirms unsatisfactory strength results. The costs of these tests shall be borne by the manufacturer.

B. Damaged, chipped or wall panels with a discolored architectural finish shall be replaced, patched or refinished as directed by the Architect and to his approval.

C. Except for hairline cracks (which are defined as surface cracks of minute width, visible but not measurable by ordinary means), the precast insulated wall panels which have become damaged, cracked or broken may be repaired following approval of a written remedial procedure by the Engineer of Record. If this repair work is aesthetically unacceptable the unit may be rejected and shall be replaced.

3.5 CLEAN UP

A. As site work progresses, remove all excess or foreign materials from the wall panel finish that occurs through the handling and erection operation.

B. On completion of the work under this Subcontract, remove all surplus materials, tools, equipment and debris, leaving the work area in a clean condition to the satisfaction of the General Contractor and Owner.

C. Prior to field application of a surface finish (paint and/or concrete stain) on the precast insulated wall panels, the painting subcontractor must prepare the surface for painting by power washing the installed panels.

D. Final cleaning of the precast concrete wall panels is the responsibility of the General Contractor/Construction Manager of the project.

END OF SECTION

SECTION 034500

ARCHITECTURAL PRECAST CONCRETE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the architectural precast concrete as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Precast/ prestressed insulated concrete panels with exposed architectural concrete finishes.

2. Provide anchorages, reinforcing bars, welded wire steel fabric, ties, supports and anchorages required for reinforcement of precast concrete units.

3. Provide all structural steel inserts, lifting hooks, anchor units, plates, dowels, etc., cast in to precast concrete members required for handling and for the connections of precast members, and all loose structural steel anchor units, angles, plates, etc., required to connect precast units to the structural framework of the building.

4. Provide all structural steel anchor units, angles, plates, bearing pads, shims, bolting, welding, grouting, dry packing and all other materials and accessories necessary for the setting, connection and accurate placement of the precast concrete units to structures. Furnish complete layout details for the installation of the above.

5. Check all lines, levels, planes and pitches required for accurate placement of work of this Section.

6. Protect, repair, patch and clean all precast concrete work of this Section, as required.

7. Provide full time supervision of the erection and installation of precast concrete work.

8. Furnish all mock-up work, samples, design mixes and laboratory tests required in connection with work under this Section.

9. Prepare the engineering design calculations for all architectural precast concrete members and connections, and prepare required shop, erection and setting drawings and details for work under this Section.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Unit Masonry - Section 042000.

C. Miscellaneous Metals - Section 055000.

D. Thermal Insulation - Section 033000.

E. Sheet Metal Flashing - Section 033000.

F. Joint Sealers - Section 079200, for sealant work between precast concrete units.

G. Expansion Control - Section 079500.

1.4 REGULATIONS AND REFERENCE STANDARDS

A. All work shall be done according to the following codes and reference standards unless specifically shown or specified otherwise in Contract Documents:

1. Local Building Code.

2. ACI 318: "Building Code Requirements for Reinforced Concrete."

3. ACI 315: "Manual of Standard Practice for Detailed Reinforced Concrete Structures."

4. ACI 211.1: "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete."

5. ACI 304-73: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."

6. ACI 347: "Recommended Practice for Concrete Formwork."

7. PCI MNL-117: "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

8. PCI Design Handbook, Precast and Pre-Stressed Concrete.

9. AISC Manual of Steel Construction, Latest Edition.

10. AWS D1.1 - Rev. 2: "Structural Welding Code."

11. AWS D12.1: "Reinforcing Steel Welding Code."

12. Applicable ASTM Specification.

13. Industrial Fasteners Institute, Handbook for Fastener Standards.

B. The Contractor shall have available at all times for reference the above regulations, standards, etc., editions noted (or the latest edition, if edition is not noted).

C. Where reference is made to Specifications of American Society for Testing Materials (ASTM) or other specific standards, furnish material and/or work in strict accordance with referenced standard, subject to any qualifications herein.

D. In the event of discrepancies between various regulations and standards referred to above, most stringent requirements govern.

1.5 REJECTIONS

A. Defective Work

1. Precast concrete units which do not conform to the specified requirements, including dimensional tolerances, strength, and finishes, shall be repaired or replaced with precast concrete units that meet the requirements of this Section. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the precast concrete work.

2. Defective precast concrete units and materials that do not comply may be rejected at any time, whether in place or not. Promptly repair to the satisfaction of the Architect or remove and replace rejected precast concrete units and materials at no additional cost to the Owner.

B. Dimensional Tolerances: Units having any dimension smaller or greater than required, and outside the specified tolerance limits, will be considered deficient and shall be rejected if the appearance or function of the unit is adversely affected, or if the larger dimensions interfere with other construction. Repair, or remove and replace, rejected units as required to meet the construction conditions.

C. Strength Deficiencies

1. When there is evidence that the strength of a precast concrete unit does not meet specification requirements determined by the Precast Engineer, the Owner's Testing Laboratory, upon direction from the Architect, and with the Owner's written approval, shall take cores drilled from hardened concrete or perform non-destructive strength tests to determine compressive strength.

2. Determination of compressive strength by drilled cores shall comply with ASTM C42 and as follows:

a. Take at least three (3) representative cores from precast units of suspect strength, from locations directed by the Architect.
b. Test cores in a saturated surface dry condition per ACI 318 if the concrete will be wet during the use of the completed structure.
c. Test cores in an air-dry condition per ACI 318 if the concrete will be dry at all times during use of the completed structure.
d. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least eighty-five (85) percent of the twenty-eight (28) day design compressive strength.
e. Test results will be made in writing on the same day that tests are made, with copies to the Architect and Contractor. Include in test reports the project identification name and number, date, name of precast concrete manufacturer, name of concrete testing service, identification letter, number, and type of member or members represented by core tests, nominal

maximum size aggregate, design compressive strength, compression breaking strength and type of break (corrected for length diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moistened condition of core at time of testing.

3. Patching: Where core test results are satisfactory and precast units are acceptable for use in the work, fill core holes solid with patching mortar, and finish to match adjacent concrete surfaces.

D. Finishes: Architectural precast concrete units whose finish has any of the following defects will be rejected. Repair the following finish defects if permitted by the Architect or remove and replace rejected units as required to meet the requirements of this Section.

1. Does not match previously approved samples as to uniformity of color or texture.
2. Has chipped, ragged, irregular or broken corners or edges.
3. Joints, false joints, drips or notches are not properly located or aligned.
4. Has damaged surfaces, notches or other surface defects.
5. Excessive air pits and voids evident on the exposed surfaces.
6. Adjacent flat and return surfaces with more than a slight difference in exposure.
7. Casting lines evident from different placements.
8. Visible form joints or irregular surfaces.
9. Rust staining on panel surfaces.
10. Blotching or acid stains evident on panel surfaces.
11. Foreign material embedded in the facing mix.
12. Cracks visible after wetting.
13. Visible repairs.
14. Reinforcement shadow lines.

1.6 DESIGN CRITERIA

A. The Contractor shall be responsible for the engineering design of all architectural precast concrete work, including connections, reinforcement and installation of the architectural precast concrete units. The Contractor shall also be responsible for the locating and placing of all items required for connections to all other work.

B. Engineering design of precast members shall be done by a Professional Engineer, licensed in the State of New Jersey, with experience in precast concrete design.

1. Structural Criteria: Design architectural precast concrete units to:

a. Panels and connections shall be designed for their gravity loads.

b. Panels and connections shall be designed for lateral wind load pressures as follows:
c. Typical Panels: As per Code.
d. Connections of panels to structural supporting members shall be made so as to not induce eccentric or torsional forces in the supporting members.
e. Allow for expansion and/or contraction, without harmful affect to the units, connections, joint seals, or adjoining construction due to a temperature range of 0 degrees F to 120 degrees referenced to 70 degrees F.

2. Connections: Design all connections for the effect of shrinkage forces, temperature changes, and deflection of the supporting or adjacent structures. Connections shown on the Contract Drawings do not relieve the manufacturer of the responsibility for the design and performance of connections.

3. Reinforcing: Conform to requirements of ACI 318-77. Reinforce all bearing areas against diagonal tension, splitting, rupture and flexure. Place extra ties, stirrups and reinforcing bars at support points. Allow no bearing pressure in edges of unreinforced section.

4. Corners: Exterior corners of precast panels shall return at the corner of each unit as indicated on the drawings. No mitered joints at exterior corner shall be allowed.

5. Lifting Devices: All inserts to be used for lifting or handling shall be on non-exposed surfaces.

1.7 QUALITY ASSURANCE

A. Fabricator and Erector Qualifications: Only a firm or firms with a minimum of ten (10) years successful experience in the fabrication and/or erection of architectural precast concrete units similar to units required for this project will be acceptable. Fabricator, erector and all other subcontractors for precast concrete work are subject to acceptance by the Architect. Fabricator must have adequate physical facilities and sufficient production capacity to produce, transport and deliver the required units without causing delay in the work. Erector must have sufficient equipment necessary to erect precast concrete work without causing delay in the work. Fabricator and erector both must submit proof of successful completion of similar and comparable work and demonstrate that they have experienced personnel and management capability sufficient to execute the work of this Section.

B. The precast concrete manufacturing plant and manufacturer shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program, Certification shall be for Group A, Architectural Products.

1.8 SUBMITTALS

A. Shop Drawings: Prepare shop drawings, details and schedules as required to fully illustrate details of work and to meet job conditions. Provide separate shop drawings for mock-up work. The shop drawings shall include, but are not limited to, the following:

1. Location of each identified precast concrete unit in the completed structure. Show all openings and all dimensions. Show relationship to structural framing members. Show concrete types, strengths and finishes.

2. Show reinforcing details, including grade, type and size of reinforcing bars, welded wire fabric.

3. Details of Connections: Show joints, bearings, connection devices, length and types of welds, all related embedded items and grouting and dry packing.

4. Show jointing clearances and clearances between the units.

5. Show full size typical details of joints between units, showing methods of sealant installation, coordinated with sealant contractor.

6. Prepare shop drawings in accordance with "Manual of Standard Practice for Detailing Reinforced Concrete Structures" (ACI-315), except where in conflict with local building regulations. Scale of details shall be adequate to fully and clearly illustrate work.

7. Submit complete design calculations for all precast members and connections. Indicate all design loads, including live loads, wind loads, seismic loads, and dead loads and including all stresses during shipment and erection and due to loads from construction procedures. Design calculations shall be done by Precast Concrete Contractor's Professional Engineer, licensed to practice in the State of New York. Calculations shall be submitted a minimum of four (4) weeks prior to scheduled start of fabrication. Design calculations shall be based on the design requirements specified herein.

    a. Panels and connections shall be designed for their gravity loads.
    b. Panels and connections shall be designed for lateral wind load pressures as follows:
        1). Typical Panels: Per Code.
    c. Connections of panels to structural supporting members shall be made so as to not induce eccentric or torsional forces in the supporting members.

B. Samples: Submit the following samples:

1. Cement and aggregates for architectural precast concrete.

2. Submit two (2) 12" square by 1-1/2" thick samples of each type of surface required (formed or unformed) showing finishes proposed for all exposed precast concrete work, using the proposed concrete mix and cast against the same form material to be actually used in the construction, finished as specified. Resubmit samples until satisfactory to Architect. Small size samples must be accepted by Architect prior to making of full-size sample or starting fabrication.

3. Prior to production fabrication of precast concrete units, provide a full-size sample of each shape and type of the required precast concrete units at manufacturer's plant for Architect's review. Notify Architect when full size sample is ready for inspection. Do not start production fabrication of precast concrete units until the full-size sample has received Architect's written acceptance. Form materials are subject to rejection if forms used do not provide finish specified. Accepted full size sample shall be set up for display at the precast plant, be adequately protected from damage, and shall serve as the standard of acceptance for similar precast concrete units installed in the work, which shall be equal to and correspond in all

respects to the approved full-size sample. Approved full size sample may be incorporated in the work, provided it is still in acceptable condition.

4. Architect's approval of small size and full-size precast concrete samples will be for color, texture, appearance and general condition only. Compliance with all other requirements of the Contract Documents is the exclusive responsibility of the Contractor.

5. Sample of patching methods.

C. Mock-Up: Prior to the approval for fabrication of any precast work, but after the approval of the full-size samples, display a mock-up of the panel at the fabricator's plant.

D. Submit Name of Manufacturer and/or Supplier for the following:

1. Cements, each type.

2. Aggregate, each type.

3. Reinforcing bars and pre-stressing tendons.

4. Welded steel wire fabric.

5. Concrete.

6. Welding electrodes.

7. Studs.

8. Inserts and anchors.

9. Non-shrink grout.

10. Neoprene pads.

11. Form release agent.

E. Certificates: Submit the following:

1. Mill certificates for all cement, identifying by lot material, of each grind and shipment.

2. Mill certificates for all reinforcing bars and welded steel wire fabric.

3. Mill certificates of all structural steel plates, shapes and members.

4. Notarized certificates of compliance of anchors, bolts, shear studs, welding electrodes, concrete inserts, neoprene pads, shop paint, field paint and non-shrink grout.

5. Certification of welders for welding reinforcement, shop and field connections.

6. Certification that precast concrete panels, required to have fire resistive rating where so indicated on drawings, are equivalent to UL listed fire rated precast concrete panels.

F. The precast concrete manufacturing plant and manufacturer shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program, Certification shall be for Group A, Architectural Products.

1. Fabricator shall comply with PCI recommended methods for patching.

1.9 TESTS AND INSPECTIONS

A. Proportioning and Test for Proportioning (by Owner's Testing Laboratory): Tests for concrete mix designs shall be by Independent Testing Laboratory engaged and paid by Owner.

B. Plant and Field Tests and Inspection (by Owner's Independent Testing Laboratory)

1. Testing Laboratory: Plant and field tests and inspection will be conducted by Contractor's Independent Testing Laboratory and/or field inspector engaged and paid by the Owner.

2. Plant Tests and Inspections by Owner's Independent Testing Laboratory shall be in accordance with PCI, MNL-117, Sections 2.1.1 and 2.1.3.

3. Field Tests and Inspection by Owner's Independent Testing Laboratory shall include, but not be limited to:

a. Erection methods.
b. Connections in accordance with approved shop drawings.
c. Welding of connections.
d. Compliance with erection tolerances.
e. Compliance of all members with sizes, types and finishes.
f. Checking leveling and grouting.
g. Inspection of bearing pads.
h. Field tests for concrete strength, if required.
i. Checking and cleaning of joint edges prior to erection of units and width of joints between erected units.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage of Materials

1. General: Store unpackaged materials on clean platforms and protect from deterioration and intrusion of foreign matter with suitable covers. Immediately remove damaged material.

2. Cement: Store in weathering structure with floor not less than one (1) foot above ground to protect against dampness and contamination. Provide easy access for proper inspection and identification of material.

3. Aggregates: Store fine and coarse aggregates separately to avoid segregation, intrusion of dirt, or foreign materials. Stockpile aggregates at least twenty-four (24) hours before being used.

4. Reinforcing Steel and Accessories: Take care to protect against soiling, corrosion and deformation. Store in manner to facilitate selection and minimize handling.

B. Deliver precast concrete units to the project site in such quantities and at such time as will assure the continuity of the installation.

C. Store units so as to prevent cracking, distortion, staining, or other physical damage, and so that markings are visible. Lift and handle units at the designated lift and handling points only.

D. Handle, transport, store and erect units in such a manner that they will not be overstressed or damaged. Transport precast concrete units on vehicles of sufficient length with points of support as needed.

E. Recess lifting hooks and, after removal, paint the cut ends with liquid galvanizing and fill the recess with grout.

F. Stack units on properly cushioned non-staining supports to protect the edges.

G. Protect against water and ice in freezing weather, particularly holes, reglets, false joints, and other recesses.

H. Protect the work of other trades during erection and final cleaning.

I. Protect work while in progress and after installation. Use non-staining coverings.

1. Protect exposed corners where there is likelihood of damage with substantial coverings.

2. Protect exposed concrete finished surfaces from damage caused by construction equipment materials or methods, and from running water.

3. Protect all exposed concrete surfaces from damage or spillage by any trade during course of erection. Such concrete surfaces shall be free of damage at the time of acceptance. This protection shall assure prevention of damage to surfaces from paints, oils, plaster, mortar or other stains or abrasions.

4. Maintain protection until work of this Contract is complete. Remove protection when directed by the Architect.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. High Concrete Group LLC, 125 Denver Road, Denver, PA 17517. Contact: Alexandra Clayton, 717-538-8078.

B. Substitutions: Or approved equal.

2.2 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III.

1. Use only one brand and type of cement throughout the project, unless otherwise acceptable to the Architect.

2. Use white Portland cement for facing concrete mix to match Architect's control sample.

3. Standard "gray" Portland cement may be used for non-exposed backup concrete.

B. Eco-Mix Blended Portland Cement containing Supplementary Cementitious Materials (SCMs) not to exceed 40% comprising one of more of the following:

1. Ground Blast Furnace Slag, ASTM C989.

2. Silica Fume, ASTM C1240.

3. Fly Ash, ASTM C618.

C. Coarse Aggregate for Facing Mixes: ASTM C 33; stone aggregate that is hard, durable, carefully selected and graded; free of material causing staining or reacting with cement.

1. Use aggregate from same source as those used in Architect's control sample.

D. Fine Aggregate for Facing Mixes: ASTM C 33.

E. Water: Drinkable, free from foreign materials in amounts harmful to concrete and embedded steel.

F. Air-Entraining Admixture: ASTM C 260.

G. Non-Metallic, Shrinkage-Resistant Grout: Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C621, equal to one of the following:

1. Euco N.S.; Euclid Chemical Co.

2. Masterflow 713; Master Builders

3. Five Star Grout; U.S. Grout Corp.

4. Or equal approved by the Architect.

2.3 REINFORCEMENT MATERIALS

A. Reinforcing Steel and Accessories

1. Reinforcing Bars: ASTM A615, Grade 60.

2. Welded Wire Steel Fabric: ASTM A185, cold drawn wire. Supply in flattened sheets or mats. Tie wires for precast work: #16 monel metal.

3. Steel Wire: ASTM A82, plain, cold drawn, steel.

4. Reinforcing Bar Accessories: Type to suit the condition; non-corrosive.

5. For concrete surfaces exposed to view, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.4 MISCELLANEOUS MATERIALS

A. Steel Hardware Units

1. Steel Plates: Structural quality, hot rolled carbon steel complying with ASTM A 36, or ASTM A 283, Grade C.

2. Structural Size Steel Shapes: ASTM A 36.

3. Bar Size Steel Shapes, Steel Bar Flats, and Steel Bar Rounds: ASTM A 36 or ASTM A 306, Grade 65.

4. Threaded Rods: Shall be coil rods made of high tensile grade steel. The rated ultimate capacity for 3/4" rods to be thirty-six thousand (36,000) lbs., for 1" rods seventy-five thousand (75,000) lbs. Dayton Sure-Grip and Shore Co., or equal.

5. Anchor Bolts: ASTM A 307, low carbon steel bolts, regular hexagon nuts and carbon steel washers.

6. Finish of Steel Hardware Units and Fasteners: Hot dip galvanized steel complying with ASTM A 123 or A 153 as applicable.

B. Weldments: To conform with the requirements of the AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Building."

C. Shear Connectors: As manufactured by Nelson Stud Welding, KSM Products, or equal approved by the Architect.

D. Shims: Plastic, "Korolath," 80,000 psi.

E. Flashing Reglet: Twenty-eight (28) gauge (0.014") stainless steel, Type 302/304; type profile and conditions as shown on drawings.

F. Touch-Up Galvanizing Compound: "ZRC Cold Galvanizing Compound" made by the ZRC Chemical Co.

2.5 INSULATION

A. Expanded polystyrene (EPS) or extruded polystyrene (XPS); molded polystyrene as defined by ASTM C 578.

2.6 FORMWORK

A. Provide forms that are non-reactive with concrete and will produce the required finish surfaces.

B. Accurately construct forms mortar-tight and of sufficient strength to withstand all pressures due to concrete placing operations, temperature changes, and when prestressed, pretensioning and detensioning operations. Maintain formwork to provide

complete precast concrete units of shapes, lines, and dimensions indicated, within the specified fabrication tolerances.

C. Unless forms for plant manufactured prestressed concrete units are stripped prior to detensioning, design forms so that stresses are not included in precast units due to deformation of concrete under pre-stress or to movement during detensioning.

D. Refer to Article 2.8 herein for further information.

2.7 QUALITY AND PROPORTIONING (MIX DESIGN)

A. Concrete Compressive Strength: Five thousand (5,000) psi minimum, at twenty-eight (28) days.

B. Concrete Weight: All precast concrete shall be normal weight concrete having an air-dry weight of one hundred fifty (150) lbs. maximum per cubic feet of concrete.

C. Concrete Slumps: The Contractor must satisfy himself that he is capable of producing concrete of satisfactory quality and strength, that will produce the specified finishes, free of voids, honeycombing, or excessive air bubbles. Execution of this contract signifies that the Contractor accepts full responsibility for the production of concrete of satisfactory quality, strength and finishes.

D. Air-Entrained Concrete: All architectural precast concrete shall be air entrained, using the specified air-entraining admixture as per manufacturer's written instructions, to provide entrained air, by volume, in the cured concrete of between three (3) percent and six (6) percent.

E. Proportioning and Tests for Proportioning

1. Responsibility: The Contractor shall be responsible for making and paying for all concrete design mixes and tests to determine the suitability of ingredients and the proportion of specified ingredients for the concrete type and strength, of the specified air entrainment, that will be fully workable for all placing conditions and that will produce finishes acceptable to the Architect.

2. Ingredients Tests: Prior to making design mixes, the Contractor's Testing Laboratory shall conduct the following tests in accordance with the procedures referred to in the Reference Standards to assure conformance with the Project Specifications.

   a. Cement: Specific gravity of cement.
   b. Aggregates: Sieve analysis, specific gravity, soundness, percentage of voids, absorption, and moisture content of fine and coarse aggregate. Dry rodded weight of coarse aggregate. Fineness modulus of fine aggregate.

3. Concrete Design Mixes

   a. Design Mixes: The Contractor's Independent Testing Laboratory shall recommend the design mixes to be used for the project for the type and strength of concrete that will produce concrete of specified strengths and finishes. Design mixes shall indicate water-cement ratio, water content, admixture content, cement content, aggregate content, aggregate gradations,

slump, air content and strength. Design mixes and related tests shall be in accordance with the procedures referred to in the Reference Standards.

b. Trial Mixes: For the type and strength of normal weight concrete, made four (4) trial mixes, using varying water-cement ratios.

c. Strength of Trial Mixes: Per ACI Standards.

4. Additional Tests: Contractor, at no expense to the Owner, shall have the Contractor's Testing Laboratory conduct additional tests on concrete ingredients and make new design mixes whenever the character or source of ingredients is changed or if the placed concrete fails to meet specified strengths.

2.8 FABRICATION

A. Reference Standards: Fabricate precast concrete units so as to comply with the manufacturing and testing procedures and quality control recommendations of Precast Concrete Institute's MNL-116 and MNL-117 "Manuals for Quality Control for Production of Precast Pre-Stressed Concrete Products and of Architectural Precast Products," except as modified herein.

B. Concrete: Store, measure, mix and deliver concrete in accordance with PCI MNL-117, ASTM C 94, and as herein specified.

C. Formwork

1. Reference Standards: Formwork shall conform to ACI 347-68 "Recommended Practice for Concrete Formwork," and to requirements specified herein.

2. Molds: Cast precast concrete units in one-piece seamless rigid molds for exposed faces, except where two-piece molds are permitted. Molds shall be made of smooth fiberglass, or other suitable material acceptable to the Architect, conforming to shape, profile, lines and dimensions indicated, so as to obtain a smooth finish matching Architect's samples and approved precast concrete unit full size samples. Prevent deformation of molds and maintain surfaces of molds free of irregularities, dents, sags, or damage of any kind. The forms or molds must be designed to withstand vibration and lateral forces, and must be accurate in details, with sharp corners and arrises so as to assure finished units satisfactory to the Architect and matching approved samples. There shall be no visible joints or seam lines in the molds or in the finished concrete surface, unless joint or lines are required by Architect's drawings.

3. Holes and Embedded Items: Contractor shall provide all holes and openings (both cast-in and drilled) required for his work and for work of other trades. All holes and openings shall be cast in. Contractor shall furnish and install all embedded items required for work of other trades furnished by other subcontractors. Accurately locate and position embedded items and secure to formwork. See drawings, including drawings of other subcontractors, for extent and location of holes, openings, drips and embedded items. Show all holes, openings, drips and embedded items on shop drawings. Coordinate with other subcontractors.

4. Built-In Anchorages: Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect the position of main reinforcement or the placing of concrete.

5. Form Release Coating: Before each casting, coat surfaces of thoroughly cleaned forms with a bond breaking compound before reinforcement is placed. Provide commercial formulation form coating compounds that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments or sealing (with sealant) of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's instructions.

    a. Where sealant bond is affected by form release coating, coating must be thoroughly removed by abrading surface (i.e. grinding, sandblasting, etc.) to insure no loss of adhesion of sealant.

D. Exposed Unformed Surfaces: All panels exposed to exterior on two (2) sides shall be floated and/or troweled on the unformed surface in a manner which will enable finishing to match the formed surface. Floating and/or troweling shall be consistently performed on all unformed surfaces. All unformed surfaces shall be oriented as indicated on the drawings.

E. Reinforcement

1. Reference Standards: Reinforcement shall conform to ACI 318 "Building Code Requirements for Reinforced Concrete" and to ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" and to requirements specified below.

2. Clean reinforcement of loose rust and mill scale, earth and other materials which reduce or destroy bond with concrete.

3. Reinforcement Cover: Place reinforcement to obtain the minimum coverage for concrete protection, which shall be 1-1/2" from face exposed to weather and one (1) inch from face not exposed to weather unless otherwise indicated on drawings.

4. Positioning and Securing Reinforcement: Accurately position support and secure reinforcement against displacement by formwork, construction, or concrete placement operations.

5. Welding: Perform all welding in accordance with AWS D1.1 - Rev. 2 and AWS D12.1. All welders shall be properly certified by AWS. Care shall be exercised during welding to minimize effect of welding heat. Welds shall be designed to prevent a tearing at end of weld which could cause a progressive failure. Detailed welding procedure covering all specified welds on erection and shop drawings may be requested for review and comment by the Architect.

F. Place concrete in a continuous operation to prevent the formation of seams or planes of weakness in precast units, complying with requirements of ACI 304. Thoroughly consolidate placed concrete in each precast unit by internal and external vibration without dislocation or damage to reinforcement and built in items. Internal vibration, if necessary, shall not touch reinforcement.

G. Identification: Provide permanent markings in precast units to identify pick-up points and orientation in the structure, complying with the markings indicated on the final shop drawings. Imprint the date of casting on each precast unit where it will not show in the finished structure.

H. Curing: Cure in accordance with applicable reference standards.

I. Fabricate precast architectural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

J. Fabricate units straight, smooth, and true to size and shape, with exposed edges and corners precise and square unless otherwise indicated.

1. Precast units that are warped, cracked, broken, spalled, stained, or otherwise defective will not be acceptable.

K. Finish of Formed Surfaces

1. For Architectural Precast Concrete Units: All exposed formed surfaces and exposed troweled surfaces of architectural precast concrete units shall have smooth "as-cast" finish. Where exposed aggregate finish is noted, conform to:

a. Light acid etched finish, producing a "matte" surface to match approved samples.
b. It is the intent of these specifications that no patching of architectural precast concrete will be required. In the event remedial action is required, it shall consist of patching with approved patching mortar and then texturing. No patching shall be done without the Architect's written approval.

L. Finish of Unformed Unexposed Surfaces: All unformed surfaces of precast concrete shall be consolidated, brought to a proper level with a straight edge, floated and then given the following finish:

1. Uniform Float Finish: Typically for all surfaces not exposed to view.

M. Quality Control: Precast unit manufacturer shall institute quality control procedures for the manufacture, inspection and testing of precast units in compliance with recommendations of PCI MNL-117. Furnish the Architect and Owner's Testing Laboratory with copies of test reports and/or certifications for materials and quality control testing of precast units.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where architectural precast concrete elements are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected by the responsible trade to permit proper installation of the work.

3.2 INSTALLATION

A. Deliver anchorage items which are to be embedded in other construction before start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.

B. Do not install precast units until concrete has attained its design strength.

C. In handling and lifting, use only lifting inserts provided.

D. Place no precast concrete units or material in the work that is damaged.

E. Install precast concrete units plumb, level, square and true, without exceeding the recommended erection and location tolerances of PCI, MNL-117, unless more stringent requirements are specified herein. Provide temporary supports and bracing as required to maintain position, stability and alignment as members are being permanently connected.

F. Anchor units in final position by bolting, welding, grouting, or as otherwise shown on drawings. Remove temporary shims, wedges, and spacers as soon as possible after anchoring is completed. Make adjustments as required to maintain accurate face joint dimensions.

1. At bolted connections use lock washer, "Slotlok" system welding or other approved means to prevent loosening of nuts.

2. At welded connections apply galvanizing touch-up compound specified herein.

G. Welding: Perform all welding in compliance with AWS D1.0 and D12.1, including qualifications of welders.

H. Protect units from damage by field welding or cutting operations during erection and provide non-combustible shields as required.

3.3 ERECTION TOLERANCES

A. Install precast architectural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.4 CLEANING

A. After erection of architectural precast concrete units and after completion of joint treatments and when other work has been substantially completed, clean exposed architectural precast concrete work to remove all dirt, dust, blemishes, stains or other discolorations. Clean exposed architectural precast concrete work by brushing vigorously with non-staining detergent and clean water. Drench and rinse architectural precast concrete units with clean water. Cleaning, washing, rinsing and other methods necessary to clean architectural precast concrete shall be in accordance with architectural precast concrete manufacturer's recommendations, as approved by the Architect. Do not use cleaning materials or processes which could change the character or appearance of the exposed architectural precast concrete finishes.

B. Protect other work from damage due to cleaning operations.

END OF SECTION

SECTION 035416

CEMENT LEVELING COMPOUND

PART 1 GENERAL

1.1 DESCRIPTION

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the cement leveling compound as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Self-leveling cement compound applied over existing concrete substrates; thickness shall be 1/4" minimum.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

1.4 QUALITY ASSURANCE

A. Applicator: Company specializing in performing the work of this Section with a minimum of 3 years' experience and approved by the manufacturer of the product used.

1.5 SUBMITTALS

A. Submit catalog information and product data for material to be used.

B. Submit approval letter as required by Article 3.1, para. B. herein.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.7 MOCK-UP

A. Construct a mock-up of underlayment material, 8 feet long by 8 feet wide.

B. Locate where directed by the Architect.

C. Approved mock-up may remain as part of the Work.

1.8 JOB REQUIREMENTS

A. Do not install underlayment until floor penetrations and peripheral work are complete.

B. Maintain minimum ambient temperatures of 50 degrees F. 24 hours before, during, and 72 hours after installation of underlayment.

C. During the curing process, ventilate spaces to remove excess moisture and until underlayment is dry, allow a minimum of seven (7) days.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Subject to the requirements specified herein, provide one of the following products:

1. "Supercap SC500" by Laticrete.
2. "Sikalevel 325" by Sika.
3. "K-15" made by Ardex.
4. "Ultraplan 1 Plus" by the Mapei Corp. (rapid setting).
5. "Novoplan 2 Plus" by the Mapei Corp. (standard setting).
6. "Level Quick R/S" or "E/S" by Custom Building Products.
7. "Level-1" by XL Brands (Bostik, Inc)
8. "SL-100" Bostik, Inc.
9. Or approved equal.

2.2 MATERIALS

A. Underlayment: One of the above listed products.

B. Water: Potable and not detrimental to underlayment mix materials.

C. Primer: Manufacturer's recommended type.

D. Joint and Crack Filler: Latex based.

2.3 MIXING

A. Site mix materials in accordance with manufacturer's instructions.

B. Mix to achieve following characteristics:

1. Density: 115 lb./cu. ft. minimum dry density.
2. Compressive Strength: 4,000 psi minimum in accordance with ASTM C 109.

3. Fire Hazard Classification: Flame/Smoke rating of 0/0 in accordance with ASTM E 286.

C. Mix to self-leveling consistency.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where cement leveling compounds are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

B. Manufacturer’s representative must inspect surfaces to receive cement leveling compound and approve those surfaces in writing to the Architect prior to start of application.

3.2 PREPARATION

A. Vacuum clean surfaces; remove any material (curing compounds, film, dirt) that would be detrimental to bond of cement leveling compound.

B. Prime substrate in accordance with manufacturer's instructions. Allow to dry.

C. Close floor openings.

3.3 APPLICATION

A. Install underlayment in accordance with manufacturer's instructions.

B. Place to minimum 1/4" thickness.

C. Transition to existing floor; use stiff mix to slope to align with existing adjacent floor.

3.4 CURING

A. Air cure in accordance with manufacturer's instructions.

3.5 APPLICATION TOLERANCE

A. Top Surface: Level to 1/8 inch in 10 ft.

3.6 PROTECTION OF FINISHED WORK

A. Do not permit traffic over unprotected floor underlayment surfaces and until underlayment is completely dry.

END OF SECTION

SECTION 042000

UNIT MASONRY

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the unit masonry work as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Concrete block walls and partitions.
2. Face brick.
3. Stone trim units within masonry construction.
4. Metal joint reinforcing, anchors, ties, weeps, closures, and related accessories for masonry.
5. Control and expansion joints in masonry, filled with joint fillers.
6. Through-wall flashing.
7. Cavity drainage material.
8. Chases, recesses, pockets, and openings in masonry as required for installation of work by others.
9. Building in of items furnished by others into masonry, including access doors, door frames, anchors, sleeves and inserts, and other similar items to be embedded in masonry.
10. Grouting in of metal items built into masonry work.
11. Protection, pointing and cleaning of masonry.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Miscellaneous Metals - Section 055000, for steel lintels.

C. Thermal Insulation - Section 072100.

D. Sheet Metal Flashing - Section 076200.

E. Firestops and Smokeseals - Section 078413.

F. Joint Sealers - Section 079200.

1.4 SUBMITTALS

A. Submit Shop Drawings for the following:

1. Anchoring details.

2. Control and expansion joint locations and details.

3. Special brick shapes.

4. Stone trim units.

5. Flashing at typical lintels indicating relationship of flashing to lintel hangers.

B. Submit Samples for the following:

1. Each type of face brick in sufficient number and color (not less than 5) to show full range of color, texture, and shade. Submit certification that brick meets ASTM standards specified herein.

a. Submit samples of all special shapes required, showing color range and sizes.
b. Submit samples of all stone trim required, showing color range and sizes.

2. Joint reinforcing, each type, width, and proposed location (labeled).

3. Anchors, wedges and ties, each type, width, and proposed location (labeled).

4. Joint filler, each type.

5. Flashing, including splice sample, 12" long.

6. Mortar color, 12" long cured sample.

C. Submit technical and installation information for the following:

1. Mortar materials, each material and mortar type.

2. Certification of mortar mix.

3. Flashing material, descriptive literature.

4. Concrete block, joint reinforcing, anchors, ties, and joint filler; submit manufacturer's technical and descriptive literature.

5. Block manufacturer shall submit certifications of compliance with ASTM C 90, C 331 and UL 618 prior to any job site delivery. Field sampling of concrete block may be tested by an Independent Testing Laboratory retained by the Owner according to the requirements of ASTM C 140.

D. Cleaning Procedures: Submit proposed procedures and materials for cleaning masonry work; including certification that cleaner will not adversely affect stone, gaskets, sealants, etc.

E. Delegated-Design Submittal: Comply with performance requirements and design criteria as set forth in the International Building Code/2021, NJ ed., and TMS 402/602, ACI 530, and ASCE 5, including analysis data signed and sealed by the Professional Engineer licensed in the State of New Jersey responsible for their preparation, as required.

1.5 QUALITY ASSURANCE

A. Conform to the following non-cumulative tolerances (any masonry work not meeting these standards shall be re-built as directed by the Architect).

1. Variation from Plumb:

a.	In lines and surfaces of columns, walls and arrises:	
1).	In 10 feet	1/8"
2).	In any story of 25 feet maximum	1/4"
3).	In 40 feet or more	1/4"
b.	For external corners, expansion joints and other conspicuous lines:	
1).	In any story of 25 feet maximum	1/4"
2).	In 40 feet or more	3/8"

2. Variation from the level or the grades indicated on the drawings; for exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines:

a.	In any bay or 20 feet maximum	1/4"
b.	In 40 feet or more	1/4"

3. Variation of the linear building lines from established position in plan related portion of columns and partitions:

a.	In any bay or 20 feet maximum	1/4"
b.	In 40 feet or more	1/2"

4. Variation in cross-sectional dimensions of columns and in thickness of walls:

a.	Minus	1/8"
b.	Plus	1/8"

5. Variation in dimensions of masonry openings:

a.	Horizontal dimension	-0" + 1/16"
b.	Vertical dimension	+0" - 1/16"

B. Job Mock-Up: Prior to installation of masonry work, erect sample wall panel mock-up using materials, bonding patterns and joint tooling required for final work and including cavity wall, masonry sill, window unit and sill, projecting courses, anchors, and reinforcement as detailed. Provide special features as directed by the Architect for caulking and contiguous work. Build mock-up at the site, 4' x 4' size as directed by the Architect, indicating the proposed range of colors, textures, and workmanship to be

expected in the completed work. Reconstruct mock-up if directed by the Architect until it meets with Architect's approval. Obtain Architect's acceptance of visual qualities of the mock-up before start of masonry work. Retain mock-up during construction as a standard for judging completed masonry work. Do not alter, move, or destroy mock-up until work is completed and accepted by the Architect. Use sample panels to test proposed cleaning procedures after sample panel meets with Architect's approval.

1. Approved sample panel shall remain on view at the site until completion of face brick work and shall establish the technical and aesthetic standards for the Project.

2. Architect shall direct distribution of brick color and texture variation within mock-up.

C. Factory Control

1. The Architect reserves the right to visit the brick manufacturer's facility and review pre-sorting so that all brick falls within a color range acceptable to the Architect.

2. 4' x 4' mock-ups shall be constructed at the factory using the face brick specified. This mock-up, after approval of the Architect, shall become the quality control panel for the selected brick.

3. Prior to any shipment of the face brick from the factory, the Architect reserves the right to inspect the brick for the thoroughness of the pre-sorting and to reject any brick that, in his opinion, does not fall within acceptable color range.

D. Work of this Section shall conform to the requirements of the following:

1. 2022 edition, "Building Code Requirements and Specification for Masonry Structures," (TMS 402/602-22).

2. Brick Industry Association (BIA) "Technical Notes on Brick Construction."

E. Pre-Construction Conference: Prior to installation of masonry and associated work, Contractor shall arrange a meeting with Masonry Subcontractor, installers of related work, and other entities concerned with masonry wall performance, including the Architect and Owner. Contractor shall record discussions and agreements and furnish copy to each participant. Provide at least seventy-two (72) hours' advance notice to participants prior to convening conference. Review methods and procedures related to masonry work, including, but not limited to, the following:

1. Review masonry requirements (drawings, specifications, and other Contract Documents).

2. Review required submittals, both completed and yet to be completed.

3. Review and finalize construction schedule related to masonry work and verify availability of materials, installer’s personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review required inspection, testing, certifying and material usage accounting procedures.

5. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.

6. Coordinate work with air/vapor barrier membrane and related flashing, review details to avoid conflicts.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Deliver, store, handle and protect all materials from damage, moisture, dirt, and intrusion of foreign matter. Store all masonry units and mortar materials on raised platforms and under ventilated and waterproof cover. Store packaged materials in manufacturer's unopened containers, marked with manufacturer's name and product brand name. Immediately reseal containers after partial use. Remove and replace damaged materials.

B. Masonry Units: Pack, deliver and store to prevent breakage, cracking, chipping, spalling or other damage. Store, protect and ventilate units at project site.

C. Aggregate: Store with provisions for good drainage.

D. Reinforcement and Anchors: Store and protect so that when placed, joint reinforcement and anchors will be free of soil, dirt, ice, loose rust, scale, or other coatings which would destroy or reduce bond with mortar and will not be disfigured or bent out of shape.

1.7 TESTING FOR EFFLORESCENCE

A. Test selected face brick for efflorescence in accordance with ASTM C 67.

B. If, at the end of the test period, the samples of brick or mortar show efflorescence, the materials represented shall be rejected and new materials shall be re-tested. This process shall be repeated until no efflorescence appears. Testing shall be done by an independent testing laboratory at the expense of the Contractor; submit test results in writing to the Architect.

1.8 JOB CONDITIONS

A. In cold weather, when the outside temperature is below forty (40) deg. F., conform to the requirements of "Cold Weather Masonry Construction and Protection Recommendations" publication by Brick Industry Association (BIA). No anti-freeze admixtures are permitted.

1. In addition, conform to the following:

a. Masonry materials must be warmed as required.
b. Brickwork must be protected a minimum of 24 hours after installation so as to maintain enough heat for hydration of the cement in the mortar.

B. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg. F. and above. In addition, conform to the following:

1. Masonry materials must be cool.

2. Mortar must be used within 2 hours of initial mixing.

C. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24" down both sides and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24" down face next to unconstructed wythe and hold cover in place.

D. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt on completed masonry.

1.9 ATTIC STOCK

A. Provide additional 10% of dry mortar mix labeled, packaged, and delivered to location determined by Owner for attic stock.

B. Provide additional 5% of brick labeled, packaged, and delivered to location determined by Owner for attic stock.

PART 2 PRODUCTS

2.1 MATERIALS

A. Standard Concrete Block

1. Portland cement, ASTM C 150, Type 1, low alkali (less than 0.6%), single source for entire project.

2. Aggregates, ASTM C 331, lightweight expanded shale, clay, or slate aggregates, manufactured by the rotary kiln process equal to "Solite," "Norlite," or "Haydite."

a. Block scheduled to receive painted finish shall contain normal weight aggregate meeting ASTM C 331 in addition to lightweight aggregate in order to receive a smooth, uniform finish.

3. Concrete Masonry Units: Load bearing lightweight aggregate concrete masonry units conforming to the requirements of ASTM C 90, Type 1.

    a. Block behind face brick and block for rated walls shall be 75% solid units.
    b. All other block may be hollow units.

4. The producer of the concrete masonry units shall furnish certification from an independent testing laboratory confirming that all 8" or larger masonry units meet all of the UL 618 requirements for two (2) hours or better (as required), referencing full scale fire test reports (ASTM E 119). All 4" and 6" units shall conform to "National Bureau of Standards" and "National Research Council" full scale fire tests.

5. Sizes and Shapes: Nominal face size 8" x 16" by thickness as indicated on drawings, with stretcher units, jamb units, header units, square corner units (at ends and corners of exposed or painted work), sash units (at control joints within masonry wall), lintel units and other special shapes and sizes required to complete the work.

6. Finish: For exposed or painted block surfaces, in addition to ASTM requirements, block shall have uniformly dense, flat, fine grain texture, with no cracks, chips, spalls, or other defects which would impair appearance. For concealed CMU, surfaces shall be free from deleterious materials that would stain plaster or corrode metal.

7. Curing: All concrete block shall be steam cured, and air dried for not less than thirty (30) days before delivery.

8. Density of concrete block shall not exceed one hundred and five (105) lbs. per cubic foot.

9. Shrinkage: Shrinkage of concrete blocks shall not exceed 0.065% when tested in accordance with ASTM C 426, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

10. Water Content

    a. At the time of delivery to the job site, concrete masonry units shall have a value, in weight of contained water, of not more than thirty (30) percent of the fully saturated content for the unit tested.
    b. Ship all units from the factory, and store at the job site, with all necessary protection to prevent increase of water content from rain and other sources.

B. Brick

1. Size: Unless otherwise indicated, provide 3-5/8" deep x 2-1/4" high x 7-5/8" long modular bricks.

2. Facing Brick: ASTM C 216, Grade SW, Type FBX.

3. Where brick is fully concealed provide common brick conforming to ASTM C 62, Grade SW.

4. Provide all special molded shapes as indicated on the drawings.

5. For sills, caps and similar applications resulting in exposure of brick surfaces which otherwise would be concealed from view, provide uncored units with all exposed surfaces finished.

C. Stone Trim Units: Stone for trim, sills, copings, etc. used in masonry walls shall be stone to match existing, of dimensions and profiles shown on drawings.

1. Color and Finish: Match existing.

2. Provide stone units accurately shaped, with exposed faces dressed true, and with beds and joints at right angles to faces.

D. Joint Reinforcing for Masonry Walls

1. For anchoring face brick to CMU back-up, provide "280 S.I.S. Dub'l Loop-Lok Seismiclip Interlock System" as manufactured by Hohmann & Barnard or equal by manufacturer noted below in Para. C.4. All wire used in assembly shall be 3/16" dia. Assembly shall contain ladder reinforcing, welded loops, box tie, seismiclip and continuous wire in face brick mortar joint. Provide special formed prefabricated pieces at corners and intersections of walls or partitions. Reinforcing wire in face brick mortar joint to extend at least 2" into face of brick. Show anchor locations on approved shop drawings.

a. Reinforcing assembly shall be hot dip galvanized steel finish conforming to ASTM A 153 with zinc coating of 1.5 oz. of zinc per sq. ft, after fabrication.

2. For interior block walls and partitions, provide standard reinforcing fabricated of 9 ga. side and cross rods, truss or ladder design, no ties, spaced every other block course. Provide prefabricated pieces at corners and intersections of walls or partitions. Reinforcing shall be mill galvanized conforming to ASTM A 641, Class B-1, applied after fabrication.

3. Wire used in assemblies noted above shall be cold drawn steel wire conforming to ASTM A 82.

4. Approved Joint Reinforcing Manufacturers

a. Hohmann & Barnard
b. Wire-Bond
c. Heckmann Building Products
d. National Wire Products Industries, Inc.

E. Anchors and Ties

1. Dovetail Anchor Slots: Hot-dip galvanized steel, 16 gauge, equal to No. 100 Dovetail Anchor Slot made by Heckmann Building Products, No. 305 anchor slot made by Hohmann & Barnard, or approved equal by other manufacturers in Para. D.4.

a. Flexible Metal Ties for Dovetail Slots: Hot-dip galvanized, 16 gauge by 1" wide by Heckmann Building Products Inc., or approved equal manufacturer noted above in Para. D.4.
   1). No. 106 Dovetail Corrugated Anchor.
   2). No. 129 Dovetail Triangle Tie.

b. For anchoring face brick to concrete back-up where there are no dovetail slots provided, provide "CMU/Concrete Screw Wing-Nut Pos-I-Tie" with five (5) gauge hot-dip galvanized (ASTM A 153, Class B-2) wire pintle tie made by Heckmann Building Products, or approved equal by manufacturer noted above in Para. D.4.

2. Wire Mesh: Hot-dip galvanized sixteen (16) gauge steel wire, square mesh, width 3" by length to suit condition; No. 268 by Heckmann Building Products, or approved equal by manufacturer noted above in Para. D.4.

3. For anchoring masonry to structural steel, provide hot-dip galvanized steel, as listed, or approved equal by manufacturer noted above in Para. D.4:

   a. Made by Heckmann Building Products. Galvanizing shall conform to ASTM A 153, with zinc coating of 1.5 oz. of zinc per sq. ft.
      1). No. 195 Column Anchors.
      2). No. 197 Column Anchors.
      3). No. 315 Weld-On Anchor Rods with No. 316 Triangle Ties.
      4). No. 315-B Weld-On Anchor Straps with No. 316 Triangle Ties.
   b. Made by Hohmann & Barnard or approved equal. Galvanizing shall conform to ASTM A 153, with zinc coating of 1.5 oz. of zinc per sq. ft.
      1). No. 355 Column Anchors.
      2). No. 356 Column Anchors.
      3). No. 357 Beam Anchors.
      4). No. 359 F anchor straps with VWT tie.

4. For anchoring CMU interior partitions to underside of steel beams, provide hot dip galvanized steel tube anchors equal to No. 419 and No. 421 made by Heckmann Building Products, No. PTA-420 made by Hohmann & Barnard, or approved equal by manufacturer noted above in Para. D.4.

5. For anchoring CMU interior partitions to underside of structural deck, provide 4" x 4" x 1/4" galvanized steel angles (ASTM A 36), 3'-0" long spaced 3'-0" o.c. alternately on each side of partition. Anchor partition securely to structural deck.

F. Reinforcing Bars and Rods: ASTM A 615, Grade 60. See Drawings for size.

G. Control and Expansion Joint Fillers

1. Vertical Installation Within Concrete Masonry Wall: Extruded high-grade neoprene rubber, cross shape, for use with concrete masonry sash units, which shall provide a force fit in the grooves of the sash block and shall have 1/2" diameter tubular ends (compressed 25% when installed in 3/8" wide joint).

   a. Provide the following sizes:
      1). 2-5/8" wide control joint fillers for 4" block walls.
      2). 4-5/8" wide for 6" block walls.

3). 6-5/8" wide for 8", 10" and 12" block walls.

b. Provide backer rod and sealant joint over joint filler as per drawings and Section 079200 of these specifications.

2. Isolation Joint Filler at Abutting Construction and at Intersecting CMU Walls: Compressible and resilient closed cell neoprene gasket with pressure sensitive adhesive backing, thickness 30% greater than thickness of joint. Acceptable joint filler shall be "Everlastic, Type NN-1" by Williams Products, Inc., or approved equal. Recess joint filler and install backer rod and sealant as per drawings and Section 079200 of these specifications.

3. Within Face Brick: Provide filler rod and sealant installed by Section 079200. Filler depth shall be 2 times joint width.

   a. Compressible filler between top of brick and bottom of shelf angle shall be "Soft Joint Sealant" made by Polytite, or approved equal.

4. Within Expansion Joint at Face Brick: Manufacturer's standard preformed, pre-compressed, open-cell polyurethane foam sealant impregnated with a water based, non-drying polymer modified acrylic water repellent. Provide "Seismic Colorseal" installed to twenty-five 25 percent compression, as manufactured by Emseal, or approved equal.

   a. Properties: Permanently elastic, mildew resistant, non-migratory, non-staining, and compatible with joint substrates and other joint sealants. Density: 8.4 to 9.1 lb./cu. ft.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type 1, standard color, one source.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregate for Mortar: Clean, washed, buff colored sand, graded per ASTM C 144.

D. Aggregate for Grout: ASTM C 404.

E. Water: Clean, fresh, and suitable for drinking.

2.3 MORTAR MIX

A. Exterior Face Brick Construction: Mortar mixes shall meet ASTM C 270, Type N, cement/lime mortar. Colors of mortars shall use coloring agent made by Davis Colors, Lehigh Cement or approved equal. Color of mortar to meet with Architect's approval. The Contractor may use pre-packaged colored mortar equal to "Color Mortar Blend" made by Glen-Gery.

   1. Color of mortar must match Architect’s approved sample and mock-up panel.

B. Exterior Block Back-Up Construction: Provide Portland cement/lime mortar as noted above conforming to ASTM C 270, Type N.

C. Interior Masonry Construction: Provide Portland cement/lime mortar conforming to ASTM C 270, Type N, for load bearing conditions, mortar shall conform to ASTM C 270, Type M.

D. Reinforced Concrete Block: Provide Portland cement/lime mortar conforming to ASTM C 270, Type S.

E. Grout for Unit Masonry: Comply with ASTM C 476 for grout for use in construction of unit masonry. Use grout of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout. Grout shall have a minimum compressive strength of 3000 psi when tested in accordance with ASTM C 1019.

F. Mixing

1. General: Add cement just before mixing and mix dry. Use sufficient amount of water as necessary to produce workable mix. Mix in small batches to make plastic mass.

2. Mixing: Machine mix all mortars in approved type mixer with device to accurately and uniformly control water. Add hydrated lime dry. Mix dry materials not less than two (2) minutes. Add water, then mix not less than three (3) minutes, not to exceed five (5) minutes. Mix only amount of mortar that can be used before initial set. Do not use mortar which has reached its initial set or two (2) hours after initial mixing, whichever comes earlier. Mortar may not be re-tempered. Clean mixer for each batch, whenever mortar type is changed, and at end of each day's work.

3. Acceleration or other admixtures not permitted.

4. Mortar shall have a flow after suction of not less than seventy-five (75) percent of that immediately after mixing as determined by ASTM C 91.

G. Admixtures

1. No air-entraining admixtures or cementitious materials containing air-entraining admixtures shall be used in the mortar.

2. No antifreeze compounds or other substances shall be used in the mortar to lower the freezing point.

3. Calcium chloride or admixtures containing calcium chloride shall not be used in mortar.

2.4 MASONRY ACCESSORIES

A. Neoprene Joint Filler: Provide closed cell neoprene, Type NN-1, conforming to ASTM D 1056, Grade 1, high performance, as manufactured by Williams Products Inc., or equal made by D. S. Brown, Norton, or approved equal.

B. Weep Holes: Provide clear plastic weep holes 3/8" wide and 1-1/2" high by four (4) inches long equal to No. 342 made by Hohmann & Barnard or approved equal manufacturer listed above.

C. Through-Wall Flashing: Provide sheet membrane flashing as part of exterior wall membrane system. Provide sealants and tapes as recommended by the manufacturer. Provide preformed corner sections "end dams" with system when flashing is discontinuous.

1. Provide flashing for surface adhered applications at sheathed areas with 26 ga. stainless steel termination bar.

2. Wall flashing shall have 26 ga. stainless steel drip edge adhered to edge of flashing, drip edge shall be set in sealant as specified in Section 079200.

D. Cavity Drainage Material: Provide 10" high HDPE "Mortar Net" open mesh mortar net of width to fit masonry cavity shown on drawings, manufactured by Hohmann & Barnard, Inc., or equal "Mortar Break II," made by Advanced Building Products.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that masonry may be completed in accordance with all pertinent codes and regulations, the referenced standards, and the original design.

3. Do not start any work until mock-ups are approved by the Architect.

B. Discrepancies: In the event of discrepancy, immediately notify the Architect in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved. Starting of work by the Contractor means acceptance by the Contractor of the substrate.

3.2 COORDINATION

A. Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this Section.

3.3 PREPARATION

A. Brick

1. Wet brick having an initial rate of absorption greater than 30 grams per 30 square inches when tested per ASTM C 67. Wet bricks by allowing water to run on the cubes or pallets of brick, or placing them in a large tank of water.

2. Except for absorbent units specified to be wetted, lay masonry units dry.

B. Concrete Block: Do not wet concrete block units.

3.4 INSTALLATION

A. General

1. Build walls to the full thickness shown. Build single wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown.

2. Build chases and recesses as shown or required for the work of other trades.

3. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.

4. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to properly locate openings, movement type joints, returns and offsets. Avoid the use of less than half size units at corners, jambs and wherever possible.

5. Lay up walls plumb and true with courses level, accurately spaced and coordinated with other work.

6. Provide templates made of steel studs for plumbing of two-story masonry openings.

7. Pattern Bond: Lay exposed masonry patterns as noted on drawings. If not shown, provide running bond. Lay concealed concrete block with all units in a wythe bonded by lapping not less than two (2) inches. Bond and interlock each course of each wythe at corners. Do not use units of less than four (4) inches horizontal face dimensions at corners or jambs.

8. Where possible, masonry walls and partitions shall be built after all overhead ducts, pipes and conduits are in place and tested. Masonry shall be neatly built around the items above. Walls and partitions shall be plumb, true to line and free from defects such as open cells, voids, dry joints and other similar defects. In rooms and spaces scheduled to have concrete block finish, all such surfaces including upper wall surfaces up to termination of structural ceiling in spaces without suspended ceilings, shall be made suitable for paint application. Cutting of openings in walls and partitions in place shall be done only with the approval of the Architect.

9. Do not use any bricks that do not meet chippage and tolerances of the applicable ASTM standard noted herein for the grade, type, or class of brick.

10. Mortar, ties and reinforcement must not extend into or bridge any expansion joints.

11. For best appearance and water resistance, tuckpoint scored joints on interior and exterior applications.

B. Mortar Bedding and Jointing

1. All joints between bricks shall be completely filled with mortar. Bed joints shall be beveled per BMI recommendations, with the brick then shoved in place. At cavity wall construction, care shall be taken that no excess mortar goes into masonry cavity. Head joints shall be completely filled with mortar and shall be

formed by applying a full coat of mortar to the entire end or the entire side, as the case requires, and then shoving the mortar covered end and/or side of the brick tightly against the bricks previously laid; the practice of "slushing" by throwing mortar into the head joints will not be permitted. All brick shall be laid without disturbing the brick previously laid. Brick shall be laid within a minute or so after the mortar is placed. Dry or butt joints will not be permitted. Grouting shall be done only as necessary. Do not slush head joints.

2. After brick placement, mortar squeezed out of bed joints shall be cut off before tooling.

3. Lay concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on exterior walls and in all courses of piers, columns, and pilasters, where solid CMU is used and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.

    a. To ensure alignment of brick and block coursing, adjust block back-up by cutting block to insure alignment of coursing or use adjustable anchorage.

4. Lay masonry walls with 3/8" joints unless otherwise shown on drawings.

5. Tool exposed joints slightly concave after the mortar joint is thumbprint hard. Concealed joints shall be struck flush, including at any CMU schedule to receive a waterproofing or air barrier membrane.

6. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

C. Stopping and Resuming Work: Rake back 1/2 brick length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

D. Built-In Work

1. As the work progresses, build in items specified under this and other Sections of these specifications. Fill in solidly with masonry around built-in items.

2. Mortar in door frames, access doors, louvers and other metal items embedded or built into masonry work solidly with mortar as the masonry units are laid up.

3. Grout under lintels, bearing plates, and steel bearing on masonry with solid bed grout.

4. Sleeves, pipes, ducts, and all other items which pass through masonry walls shall be caulked with interior grade sealant meeting requirements of Section 079200, so as to be airtight and prevent air leakage. Refer to Section 078413 for packing of voids in rated masonry walls.

5. Fill vertical cells of masonry units solid with grout that have anchoring, reinforcing rods, supporting, or hanging devices embedded in the cell, including stone anchors and window or curtain wall anchors.

6. Fill vertical cells of masonry units solid with mortar on each side of door frames to sixteen (16) inches beyond.

7. Unless otherwise noted, fill vertical cells of masonry units solid with grout that are below steel bearing plates, steel beams, and ends of lintels, to eight (8) inches beyond bearing and from floor to bearing.

8. Place wire mesh in horizontal joint below masonry unit cells to be filled with mortar, to prevent mortar from dropping into unfilled cells below.

9. Masonry indicated as being reinforced shall have all voids filled solid with grout. Grout shall be consolidated in place by vibration or other methods which insure complete filling of cells. When the least clear dimension of the grouted cell is less than two (2) inches, the maximum height of grout pour shall not exceed twelve (12) inches. When the least clear dimension is two (2) inches or more, maximum height of grout pour shall not exceed forty-eight (48) inches. When grouting is stopped for one (1) hour or longer, the grout pour shall be stopped 1-1/2" below the top of a masonry unit. Vertical bar reinforcing shall be accurately placed and held in position while being grouted and shall be in place before grouting starts. All such reinforcing shall have a minimum clear cover of 5/8". Lap all bars a minimum of forty (40) bar diameters and provide steel spacer ties (not to exceed 192 bar diameter) to secure and position all vertical steel and prevent displacement during grouting. Provide continuous horizontal reinforcement embedded in mortar joints every second course.

E. Cutting and Patching

1. All exposed masonry which requires cutting or fitting shall be cut accurately to size with motorized carborundum or diamond saw, producing cut edges.

2. Do not saw cut any masonry openings in face brick construction without Architect's approval and after a procedure has been reviewed and approved.

3. Holes made in exposed masonry units for attachment of handrail brackets and similar items shall be neatly drilled to proper size.

4. All masonry which requires patching in exposed work, if approved by Architect, shall be patched neatly with mortar to match appearance of masonry as closely as possible and to the Architect's satisfaction. Rake back joints and use pointing mortar to match as required.

F. Solid Wall Construction

1. Fill the vertical longitudinal joint between wythes solidly with mortar by parging the in-place wythe and shoving units into the parging.

2. Tie wythes with continuous horizontal reinforcement embedded in mortar joints sixteen (16) inches o.c. vertically.

G. Cavity Walls

1. Two wythes of masonry cavity walls shall be securely tied together by horizontal joint reinforcement and ties anchored to reinforcement, as herein specified, spaced every other block course.

a. Where cavity back-up is concrete use ties specified herein spaced sixteen (16) inches o.c. both directions.

2. Cavity between facing and backing wythe shall be kept clean and clear of all mortar droppings, and no mortar ledges shall project into the cavity. Temporary wood strips, cut to width of cavity and fitted with lift-up wires, shall be laid on the joint reinforcement and carefully lifted out before placement of the next layer of reinforcement. Any projecting mortar shall be spread over the back of the outer wythe immediately following the setting of the masonry unit.

   a. Cavity drainage material shall be installed at the bottom of each cavity over the flashing to protect weep holes.

3. At cavity and solid walls adjacent to window openings fill block solid with mortar where window anchors are to be located. Coordinate with window subcontractor.

4. Concrete block back-up at cavity wall construction shall be anchored to slab at top with dovetail anchors spaced sixteen (16) inches o.c.

5. Anchor CMU back-up with anchors as specified herein.

6. Refer to Section 072100, "Thermal Insulation," for material and installation of cavity wall insulation.

H. Interior Block Partitions

1. Build to full height unless otherwise shown on drawings. At non-rated partitions fill void between CMU and structural deck with continuous neoprene filler as specified herein. At fire-rated partitions, fill void with fire stop material meeting the requirements of Section 078413. Fasten to structure at top of partition using steel angles as specified herein.

2. Provide continuous horizontal joint reinforcing every other block course, except as otherwise noted. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8". Lap reinforcement a minimum of six (6) inches at ends of units.

3. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

4. Corners

   a. Provide interlocking masonry unit bond in each course at corners.
   b. Provide continuity at corners with prefabricated "L" reinforcement units, in addition to masonry bonding.

5. Intersecting and Abutting Walls

   a. Unless vertical control joints are shown as part of structural frame, provide interlocking masonry bond. Provide starters and special shapes as shown on the drawings to bond these walls.

b. In addition to masonry bonding, provide horizontal reinforcement using prefabricated "T" units at interior partitions.

I. Ties and Anchors for Masonry Construction

1. Provide ties and anchors as shown or specified, but not less than one metal tie, spaced not to exceed 16" o.c. horizontally and/or vertically. Provide additional ties within 1'-0" of all openings and adjacent to expansion joints and spaced not more than 16" apart around perimeter of openings.

2. Anchoring Masonry to Structure: Provide an open space not less than 1/2" in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.

J. Control and Expansion Joints

1. Provide expansion, control and isolation joints in masonry as shown. Build in related items as the masonry work progresses.

2. CMU Control Joint Spacing: If location of control joints is not shown, place vertical joints spaced not to exceed 40'-0" o.c. In addition, locate joints at points of natural weakness in the masonry work, including the following:

a. At structural column or joint between bay.
b. Above control joints in the supporting structure.
c. Above major openings at end of lintels upward and below at ends of sills downward. Place at one side of jamb for openings not less than 6'-0" wide and at both sides for openings over 6'-0" wide.
d. At reduction of wall thickness.
e. Where masonry abuts supporting structure.
f. If additional joints are required, indicate same on approved shop drawings.

3. Brick Veneer Expansion Joint Spacing: Vertical expansion joints in brick veneer construction shall be located maximum 20'-0" o.c. unless otherwise noted in addition to expansion joints located within 2'-0" of each corner of the building.

K. Lintels

1. Install loose steel lintels furnished by Section 055000, allowing eight (8) inch bearing at ends.

2. For concrete block walls, use specially formed U-shaped concrete block lintel units with reinforcing bars in accordance with the following table, filled with grout.

Number and Size of Reinforcing Bars Required at Concrete Block Lintels		
Maximum Clearance Span	Wall Width	Rebar No. - Size
2'-0" to 6'-0" 6'-0" to 8'-0"	6"	2 - #3 2 - #4

2'-0" to 6'-0" 6'-0" to 8'-0"	8"	2 - #3 2 - #4
2'-0" to 6'-0" 6'-0" to 8'-0"	12"	3 - #3 3- #4

3. U-shaped concrete block lintels shall extend a minimum of 8" at each side of opening.

3.5 FLASHING/WEEP HOLES

A. General: Install embedded flashing and weep holes in masonry at relieving angles, shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated. Space weeps 16" o.c. unless otherwise shown on drawings. Weeps shall occur immediately above the flashing.

B. Prepare masonry surfaces so that they are smooth and free from projections that could puncture flashing.

C. Flashing shall be placed, generally, at bottoms of cavity wall construction, over all wall openings, window jambs, at sills of window, and in other locations where indicated on the drawings. Flashing shall overlap a minimum of 6". At bottoms of cavity walls, the flashing shall be built extending from the exterior face of the brick, up and into the mortar joint 2" at the inner wythe of the CMU back-up; at sheathed areas attached with pressure bar. At concrete spandrel beams and columns, the flashing shall be installed with a termination bar. Extreme care shall be exercised in placing the masonry materials not to damage the flashing. Flashing damaged during the masonry erection shall be repaired or replaced by the Contractor at no additional cost to the Owner. Discontinuous flashing shall terminate with an end dam in a head joint, rising at least 1".

D. When spanning an air space, flashing shall be supported with a mortar wash, insulation, or treated wood blocking.

E. Where flashing is penetrated by anchors, patch flashings at penetration using adhesive and mastic recommended by the manufacturer to insure watertight seal.

F. Install flashing in accordance with manufacturer's instructions, using adhesive, primer, thinner, cleaner and mastic as recommended by flashing manufacturer.

1. Flashing shall overlap adjacent piece of flashing a minimum of 6".

G. Provide drip edge when flashing extends beyond face of brick.

3.6 CLEANING, PROTECTION, ADJUSTMENT

A. Protection

1. The Contractor shall take adequate precautions for the protection of all surfaces against mortar spatter and shall immediately remove any such spatter should it inadvertently occur, leaving no stain or discoloration.

2. Excess mortar shall be wiped off the masonry surfaces as the work progresses.

3. Wood coverings shall be placed over all such masonry surfaces as are likely to be damaged during the progress of the entire project.

4. Protective measures shall be performed in a manner satisfactory to the Architect.

5. Damaged masonry units shall be replaced to satisfaction of the Architect.

6. Exterior masonry walls shall be draped with waterproof covering until copings are in place, to prevent water penetration in cavity.

B. Cleaning of Masonry: Upon completion, all exposed masonry shall be thoroughly cleaned following recommendations of the BIA Technical Note No. 20. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 4' x 4' in a location approved by the Architect. No further cleaning work may proceed until the sample area has been approved by the Architect, after which time the same cleaning materials and method shall be used on the remaining wall area. If stiff brushes and water do not suffice, the surface shall be thoroughly saturated with clear water and then scrubbed with a solution of an approved detergent masonry cleaner, equal to "Vana Trol" made by ProSoCo Inc. or equal made by Diedrich or approved equal, mixed as per manufacturer's directions, followed immediately by a thorough rinsing with clear water. All lintels and other corrodible parts shall be thoroughly protected during cleaning.

1. Unless otherwise required by cleaning agent manufacturer use only low-pressure device (30 to 50 psi) for application of cleaning agent and water rinsing.

C. Pointing: Point any defective joint with mortar identical with that specified for that joint.

END OF SECTION

051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Structural Steel
   2. Bolts and/or Welding
   3. Shop Painting

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 PRE-INSTALLATION MEETINGS

A. Pre-Installation Conference: Conduct conference at Project Site.

1.5 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections and moment connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering design by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
   1. Select and complete connections using general notes provided on the plans and AISC 360.
   2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment drawings.
   3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
   4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.

5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
6. Prepare shop drawings in conformance with the best standards of the construction industry, and not less complete than indicated by the applicable procedures shown in "Structural Steel Detailing," latest edition, published by AISC. Prepare shop drawings under the supervision of competent engineering personnel, licensed by the state in which the construction is to take place. During the preparation of shop drawings, and prior to submittal, coordinate and cross check all shop drawings, including those prepared by subcontractors, for compliance with the Contract Documents. Each shop drawing shall bear the signature of the engineer in charge of structural steelwork for the steelwork subcontractor, and the initials of the individual actually preparing the drawing
7. Show clearly all work, including relationship of structural steel to the adjacent work of other trades and to significant lines of finishes of other trades.
8. Do not fabricate or deliver work to the site before drawings reviewed by the architect have been returned.
9. Show explicitly the type of connection used in each location, the grade, size and number of bolts; the type, number, position, designation and orientation of each hole; and the size of each hole, whether slotted or round. Ensure that adequate wrench clearance for correct bolt tightening is provided and note special bolt tightening sequences where necessary.
10. Prepare original shop drawings. The used of the engineer's or architect's drawings as a base for photographic or other reproduction for shop drawings as a base for photographic or other reproduction for shop drawings or details will not be permitted. Show clearly the size and location of each member and the erection mark assigned to each member. Show each field connection with all data and details necessary for assembling the structure. Direct special attention to the possible need for special guying, bracing, or shoring to prevent deformation of existing or new structure due to stresses caused by erection procedures and equipment, by construction loadings, and by forces of natural phenomena.
11. Prepare, keep up-to-date, and submit a complete drawing index cross-referencing each assigned piece mark with the drawing number in which the piece is detailed. Detail drawings submitted without an up-to-date index and the applicable erection drawing(s) showing the location of each piece will be deemed an incomplete submission and will not be accepted as subject to an agreed shop drawing review schedule.
12. Prepare anchor bolt and baseplate erection drawings containing complete location and placing details, including details of all templates. Provide anchor bolt erection drawings to the concrete trade in advance of applicable concrete work and in coordination with concrete construction sequence.
13. Direct the architect's attention in writing to any proposed deviations from the Contract Documents, prior to the submission of shop drawings showing the proposed deviation. Submit requests for deviations on the steelwork subcontractor's letterhead. Deviations not identified, or identified only in letters of transmittal or in shop drawings or both, without the required written request, may not be accepted, and shall be sufficient cause for the architect to return each shop drawings containing such deviations without further action. Acceptance of shop drawing containing deviations not detected by the architect during shop drawing review shall not relieve the steelwork subcontractor from responsibility to conform strictly to the Contract Documents.
14. Prior to resubmission of shop drawings with additions or corrections, circle and identify all changes. Drawings submitted without each change being clearly identified are subject to return for resubmission.
15. Prior to making shop drawings for any portion of the work involving alterations to an existing structure, make all necessary field observations, measurements and surveys of existing

conditions. If probes are required to accomplish such measurements, give timely notice where probes will be required.

C. Qualification Data: For qualified Installer, fabricator, professional engineer and testing agency.

D. Welding certificates.

E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

F. Mill test reports for structural steel, including chemical and physical properties.

G. Product Test Reports: For the following:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Non-shrink grout.

H. Source quality-control reports.

I. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer, who to the satisfaction of the Architect and Owner, has successfully completed similar projects in size and complexity to the proposed project, and who can provide suitable documentation to confirm this experience and capabilities. Said documentation shall be data for recent project experience including, but not limited to; owner name and contact information, location, name and contact information for general contractor, gross area of building, use of building, contract amount, and any other information that is deemed appropriate to communicate the installer is appropriately qualified. Installer shall also provide a copy of their detailed written quality assurance plan/program. Qualified installer shall participate in the AISC Quality Certification Program and be designated an AISC-Certified Erector, Category CSE or provide a similar quality program acceptable to the Architect.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. Pre-installation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.9 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.10 MEASUREMENTS

A. Field-Measurements: Obtain all field measurements required for proper fabrication and installation of work. Submit prior to installation, all measurements indicating discrepancies from the drawings. Describe in writing, and where applicable, by sketches proposed methods of correcting the discrepancies. Measurements are the responsibility of the contractor.

B. Lay out each part of the work in strict accordance with the architectural, structural, mechanical, electrical, plumbing and all other drawings and be responsible for correct location of the same. Lay out from at least two pre-established benchmarks and axis lines, individually correct for length and bearing.

C. Templates:Furnish templates and layout drawings for exact locations of items to be embedded in concrete, with setting instructions required for installation of embedded items.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than the following:
   1. W-Shapes: 35 percent.

2. Channels, Angles, M, S-Shapes: 35 percent.
3. Plate and Bar: 25 percent.
4. Cold-Formed Hollow Structural Sections: 35 percent.
5. Steel Pipe: 25 percent.
6. All Other Steel Materials: 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
1. Weight Class: As indicated.
2. Finish: Black except where indicated to be galvanized.

G. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

H. Steel Forgings: ASTM A 668/A 668M.

I. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 or ASTM A490; Cold forged with rolled threads. Do not use A325 and A490 bolts of the same diameter. Different grade boltS must vary in diameter by a minimum of ¼ inch.
1. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
1. Finish: Hot-dip zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating, baked epoxy-coated finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
1. Finish: Plain.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

E. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
1. Configuration: Straight or Hooked.
2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.

4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
5. Finish: Plain except where indicated to be hot-dip zinc coating, ASTM A 153/A 153M, Class C.

F. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
4. Finish: Plain.

G. Threaded Rods: ASTM A 36/A 36M.
1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
3. Finish: Plain except where indicated to be hot-dip zinc coating, ASTM A 153/A 153M, Class C

2.3 PRIMER

A. Primer for Steel to Receive High-Performance Coating: Primer shall be as specified in Division 9 Section “High-Performance Coatings.”

B. Primer for Other Steel: Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: ASTM A 780.

D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction [and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.

5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened typical; Slip critical where indicated

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP APPLIED COATINGS

A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Surfaces receiving intumescent/tnemec coatings.
6. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
   1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels, shelf angles and members which are permanently exposed to weather.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   3. Ultrasonic Inspection: ASTM E 164.
   4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened typical; slip-critical where indicated.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 051200

SECTION 051213

ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the architecturally-exposed structural steel and as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Structural Steel - Section 051200.

1.4 STANDARDS

A. Except where more stringent requirements are specified herein, comply with the applicable provisions and recommendations of the following (latest edition):

1. AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings."

2. AISC "Architecturally Exposed Structural Steel."

3. AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts."

4. AWS D1.1 "Structural Welding Code."

5. SSPC "Steel Structures Painting Manual, Volume 2, Systems and Specifications."

6. ANSI/AWS A533-9X, Specification for Alloy Wires, Cored Wire and Ceramic Rods for Thermal Spraying, American Welding Society.

7. ANSI/AWS C2.18.93, Guide for the Protection of Steel with Thermal Spraying Coating of Aluminum and Zinc, American Welding Society.

8. ASTM C 633, Standard Test Method for Adhesion or Cohesive Strength for Flame Sprayed Coatings, American Society for Testing and Materials.

9. SSPC-CS Guide 23.00, June 1, 1991, Coating System Guide for Thermal Spray Metallic Coating Systems, Steel Structures Painting Council.

1.5 QUALITY ASSURANCE

A. General: Work of this section shall be fabricated and installed by an experienced fabricator or manufacturer, who has been engaged in work of equivalent scope and

fabrication standards for at least five years. Materials, methods of fabrication, fitting, assembly bracing, supporting, fastening, and erection shall be in accordance with drawings and specifications, approved shop drawings, and be of highest quality practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected. All work shall be accurately and neatly fabricated, assembled, and erected.

B. All work for this Section shall comply with AESS Classification 4 Showcase Elements in accordance with AISC Code of Standard Practice (ANSI/AISC 303) per chart at the end of this Section.

1.6 SUBMITTALS

A. Shop Drawings: Submit shop and erection drawings for all structural steel components showing the following:

1. Types of materials, including sizes and weights of members.

2. Location, types and details of connections.

3. Welding sequences as required by "Structural Welding Code."

4. Cleaning and painting schedules.

5. Fabrication and erection procedure where needed to control shrinkage, fabrication tolerances or to insure proper inspection.

B. Reports

1. Submit certified copies of mill test reports for all steel furnished. Perform mechanical and chemical tests for all material regardless of thickness or use. No part of the ASTM Specifications will be waived without written consent of the Architect.

2. Submit copies of prequalified and other welding procedures in form prescribed in "Structural Welding Code."

C. Samples: Submit samples of each:

1. Typical welded connection.

2. Typical nut and bolt connection.

3. Paint sample painted on welded steel components.

D. Submit structural calculations and details signed and sealed by a Professional Engineer licensed in the State of New Jersey, show fabrication, sizes of members, connections and anchorage. Where member sizes vary from those shown on drawings due to structural requirements, coordinate with the Architect before fabrication.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Conform to delivery, storage and handling requirements specified in Section 051200.

B. Do not handle structural steel until paint has thoroughly dried. Care shall be exercised to avoid abrasions and other damage. Provide all necessary cradles, dunnage, padding or other protection as required during storage and transportation. Wherever possible, handle primed steel with non-marring slings or by means of shackles inserted into connection holes.

C. Stack material out of mud and dirt and provide for proper drainage. Protect shop painted steel from damage or soiling by adjacent construction operations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials that have been selected for their surface flatness, smoothness, and freedom from surface blemishes where exposed to view in the finished unit. Surfaces exposed to view that exhibit pitting, seam marks, roller marks, oil-canning, stains, discolorations, or other imperfections on the finished units will not be acceptable.

B. Structural Steel

1. ASTM A572 Grade 50 for wide flange shape.

2. ASTM A500 Grade A for square, round or rectangular shape.

3. ASTM A36 for all other steel.

C. High Strength Bolts and Nuts: ASTM A325 and ASTM A490, minimum 3/4" diameter.

D. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of the metal to be welded, and as required for color match, strength and compatibility in the fabricated items.

E. Anchors and Inserts: Either furnish inserts to be set in concrete or masonry work, or provide other anchoring devices as required for the installation of ornamental metal items. Provide toothed steel or lead shield expansion bolt devices for drilled-in-place anchors. Provide galvanized or cadmium-coated anchors and inserts for exterior installations.

1. Provide units with exposed surfaces matching the texture and finish of the metal item anchored.

2.2 FABRICATION

A. Fabrication, AESS 4

1. Use special care in handling and shipping of AESS both before and after shop painting minimize damage to any shop finish. Use Nylon type slings or softeners when using chains or wire rope slings.

2. The permissible tolerances for member depth, width, out of square, and camber and sweep shall be as specified in ASTM A6/A6M-2014 Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and

Sheet Piling (ASTM A6/A6M), ASTM A500/A500M-2013 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes (ASTM A500/A500M), and Standard Specification for Cold-Formed Welded Carbon Steel Structural Sections (HSS) (ASTM A1085/A1085M).

3. Fabricate and assemble AESS in the shop to the greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by the Architect. Detail AESS assemblies to minimize field handling and expedite erection.

4. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.

5. Remove all backing and run out tabs.

6. Grind all sharp edges smooth, including all sheared, punched or flame cut edges

7. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.

8. Bolted Connections: Make in accordance with Section 051200. Provide bolt type and finish as noted herein.

9. Weld Connections: Comply with AWS D1.1 and Section 051200. Appearance and quality of welds shall be consistent. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding the tolerance of this section.

10. Install all bolts on the same side of the connection. Oriented uniformly in the direction indicated Consistent from one connection to another.

11. Remove all weld spatter, slivers, and similar surface discontinuities.

12. Grind off projections larger than 1/16” at butt and plug welds.

13. Continuous Weld Appearance: Where continuous welding is noted on the drawings, provide welds of a uniform size and profile

14. Seal Welds: Seal weld open ends of round and rectangular hollow structural section with 3/8" closure plates. Provide venting as required for galvanized members.

15. The as-fabricated straightness tolerance shall be one-half of that specified in ASTM A6/A6M, ASTM A500/A500M, or ASTM A1085/A1085M.

16. For curved structural members, whether composed of a single standard structural shape or built-up, the as-fabricated variation from the theoretical curvature shall be equal to or less than the standard camber and sweep tolerances permitted for straight members in the applicable ASTM standard.

17. The tolerance on overall profile dimensions of welded built-up members shall be one-half of that specified in AWS D1.1/D1.1M: 2015 Structural Welding Code – Steel (AWS D1.1).

18. Provide hidden part marks or piece marks that may be fully removed after erection.

19. Fabricate AESS with exposed surfaces smooth, square and of surface quality consistent with the approved mock-up.

20. Grind projections at butt and plug welds to be smooth with the adjacent surface.

21. Orientation of HSS seams shall be as shown.

22. Copes, miters, and cuts in surfaces exposed to view shall have a maximum gap of 1/8" in an open joint. If the gap is shown to be in contact, the contact shall be uniform within 1/16".

23. Mill marks shall not be exposed to view. If it is not possible to hide mill marks, then the mill marks are to be removed by appropriate length cutting of mill material. If this is not possible, the fabricator shall remove the mill mark, grind, and fill the surface to be consistent with the approved mock-up.

24. The matching of abutting cross sections is required

25. Contouring and blending of welds: Where welds are indicated to be ground contoured, or blended, oversize welds as required and grind to provide a smooth transition and match profile on approved mock-up.

26. Minimize Weld Show Through: At locations where welding on the opposite side of an exposed connection creates distortion, weld show through shall be minimized to conform to the approved mock-up.

27. Open holes shall be filled with weld metal or body filler and smoothed by grinding or filling to the standards applicable to the shop fabrication of the materials.

B. Cutting: Cut metal by sawing, shearing, or blanking. Flame cutting will be permitted only if cut edges are ground back to clean, smooth edges. Make cuts accurate, clean, sharp, square, and free of burrs, without deforming adjacent surfaces or metals.

C. Connections

1. Make connections with tight joints, capable of developing full strength of member, flush unless indicated otherwise, formed to exclude water. Locate joints where indicated on approved shop drawings. Provide connections to allow for thermal movement of metal at locations and by methods approved by Architect. Use welded connections throughout, except where mechanical fasteners are permitted on approved shop drawings. Where mechanical fasteners are used, joints shall be accurately fitted, flush and rigidly secured with hairline contacts.

2. Welding: Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted on approved shop drawings. Welds exposed to view shall be ground flush and dressed smooth with and to match finish of adjoining surfaces so that joint will not be visible; undercut metal edges where welds are required to be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surface will be free of imperfections such as pits, runs, splatter, cracks, warping,

dimpling, depressions or other forms of distortion or discoloration. Remove weld spatter and welding oxides from all welded surfaces. Sample of welding must be available for Architect's approval.

a. All welds shall be made in accordance with the Building Code and with AWS D1.1-62 "Structural Welding Code." All welds shall satisfy structural requirements and shall also satisfy architectural requirements, as specified herein, where exposed to view. Welders shall be qualified by tests per AWS D1.1.
b. Welded connections shall be made without causing bends, twists or exposed open joints in the finished members.
c. All welds shall be continuous from end-to-end of the piece; there shall be no open joints. All exposed fillet welds shall be of the same dimension (5/16" min.) for all built-up members. Dimension of exposed fillet welds shall meet structural requirements and appearance shall be as approved by Architect.
d. All welds shall be finished in accordance with finish requirements specified herein. Welds not exposed to view shall have "as-welded" surface in conformance with AWS D1.1-72 "Structural Welding Code."

3. Bolting

a. Bolts shall be of a length that will extend not less than 1/4 in. but not more than 1/2 in. beyond the nuts. Enter bolts into holes without damaging the thread.
b. Use high-strength bolts in bearing and/or friction as shown. Make high-strength bolted joints without the use of erection bolts. Bring members tightly together with sufficient high-strength "fitting-up" bolts which shall be retightened as all the bolts are finally tightened. Manual torque wrenches will not be accepted for final tightening. Protect bolt heads from damage during placing. Bolts that have been completely tightened shall be marked for identification.
c. Final tightening of high-strength bolts shall be by properly calibrated wrenches unless turn-of-nut method is specifically permitted. Each wrench shall be checked for accuracy at least once daily.
d. Draw unfinished bolt heads and nuts tight against the work with a suitable wrench not less than 15 in. long. Mutilate bolt threads for unfinished bolts to prevent the nuts from backing off.

D. Mill column and bearing stiffeners to give full bearing over the cross section. Mill contact surfaces of bearing and base plate. It is not necessary to plane bottom surfaces of plates on grout beds.

E. Drill or punch holes at right angles to the surface of the metal, not more than 1/16" larger than the connector diameter. Do not make or enlarge holes by burning. Drill material having a thickness in excess of the connector diameter and material thicker than 7/8". Holes shall be clean-cut without torn or ragged edges. Remove outside burrs resulting from drilling operations.

F. Provide holes in members to permit connection of the work of other trades. Use suitable templates for proper location of these holes. Steel requiring adjustment shall be provided with slotted holes as shown.

G. Provide holes, slots and openings required by other trades together with necessary reinforcing as shown. Use suitable templates for proper location of these openings. Where openings are shown on the shop drawings no change in location will be permitted without prior approval.

H. The use of controlled heat straightening, curving, warping, twist or cambering is permitted. All work shall be performed in a first-class manner in accordance with the requirements of Art. 3.7.3 of AWS D1.1.

I. Fill dents with metallic filler and grind flush and smooth. Grind abrasions and other defects where finished appearance will be affected.

J. Built-In Work: Furnish anchor bolts, inserts, plates and any other anchorage devices, and all other items for architectural metal work to be built into concrete, masonry, or work of other trades, with necessary templates and instructions, and in ample time to facilitate proper placing and installation.

K. Supplementary Parts: Provide as necessary to complete each item of work, even though such supplementary parts are not shown or specified.

L. Exposed Work: In addition to requirements specified herein or shown on drawings, all surfaces exposed to view shall be clean, and free from dirt, stains, grease, scratches, distortions, waves, dents, buckles, tool marks, burrs and other defects which mar appearance of finished work. Ornamental metal work exposed to view shall be straight and true to line or curve, smooth arrises and angles as sharp as practicable, miters formed in true alignment, profiles accurately intersecting, and with joints carefully matched to produce continuity of line and design. Exposed fastenings, where permitted, shall be of the same material, color and finish as the metal to which applied, unless otherwise indicated, and shall be of the smallest practicable size.

M. Materials used shall be of such strength, thickness and alloy that they are capable of meeting all standards and descriptions specified herein and as detailed on drawings.

N. Special attention shall be given to steel requiring accurate alignment. Provide slotted holes for typical connections and sufficient length of threaded portion of rods as required.

2.3 TOLERANCES

A. Fabrication tolerances shall be as follows:

1. Rolled Shapes: Permissible tolerances for out-of-square or out-of-parallel depth, width, and symmetry of rolled shapes shall be as specified in ASTM A6. Match abutting cross-sectional configurations. The as-fabricated straightness tolerances of members shall be one-half of the standard camber and sweep tolerances in ASTM A6.

2. Built-Up Members: The tolerances on overall profile dimensions of members made up from a series of plates, bars and shapes by welding are limited to the accumulation of permissible tolerances of the component parts as provided by ASTM Specification A6. The as fabricated straightness tolerances for the member as a whole shall be one-half the standard camber and sweep tolerances for rolled shapes in ASTM A6.

3. Weld Show-Through: It is recognized that the degree of weld show-through, which is any visual indication of the presence of a weld or welds on the side away from the viewer, is a function of weld size and material thickness. The members or components will be acceptable as produced for non-visible conditions, welds exposed to view shall have no show-through.

4. Joints: All copes, miters and butt cuts in surfaces exposed to view shall be closed, no open joints permitted.

B. Erection Tolerances: Members and components shall be plumbed, leveled and aligned to a tolerance not to exceed one-half the amount permitted for structural steel. Provide adjustable connections between AESS and the structural steel frame or the masonry or concrete supports, in order to provide means for adjustment.

2.4 SHOP FINISHING OF STEEL

A. Finishing of Exterior Architectural Structural steel shall be as follows:

1. Surface Prep: SSPC-SP-10 Near White Metal Blasting, with 3-4 mil anchor pattern.

2. First Coat: Zinc/Aluminum metallizing at 4-6 mils dft.

3. Second Coat: 161 HS Tneme-Fascure at 2-4 mils dft by Tnemec.

4. Third Coat: Field applied urethane topcoat, see Section 099000.

B. Zinc for aluminum metallizing material shall consist of 85% zinc, 15% aluminum wire meeting standard noted herein. System shall be provided by Atlantic Coast Metallizing & Coatings Corp.; Richie Goelz, 516.694.9850; or approved equal.

C. The system shall meet or exceed the following:

1. Adhesion of Zinc/Aluminum Metallizing: An average of 1,5000 psi, per ASTM D4541.

2. Adhesion of Epoxy Sealer Over Zinc/Aluminum Metallizing: A rating of 5 out of 5 per ASTM D3359 after system had been exposed to 10 freeze thaw cycles (1 cycle = 4 hours 100% humidity, 16 hours in freezer, 4 hours in 140 degree oven).

3. Corrosion Resistance of Zinc/Aluminum Metallizing (0% rust at scribe after 16 months exterior exposure): A rating of 10 out of 10 (no rusting at scribe) after 4 years natural exposure.

4. Corrosion Resistance of Zinc/Aluminum Metallizing with 1 coat Epoxy sealer and 1 coat of urethane topcoat (see Section 099000): A rating of 10 out of 10 (no rusting at scribe) after 1500 hours salt fog (Prohesion Method) ASTM D1654.

D. Finishing of Interior Architectural Steel shall be as follows:

1. Surface Prep: SSPC-SP-6 Commercial Blasting.

2. Primer: "394 Perimeprime" by Tnemec

3. Shop applied 27 FC Typoxy by Tnemec. Following erection, scuff/sand the 27FC and spray on 115 Unibond DF as intermediate coat.

4. Use 1081 Endura-Shield WB as finish coat.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where architecturally-exposed structural steel is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 ERECTION

A. Erection shall be in accordance with Section 10.5 Code of Standard Practice for Steel Building and Bridges.

B. Check the alignment and elevations of all column supports and the location of all anchor bolts with transit and level instruments before starting erection. Notify Architect of any errors. Obtain Architect's approval of methods proposed for correcting errors prior to proceeding with corrections and erection.

C. Drift Pins may be used only to align the several parts. They shall not be used in such manner as to distort or damage the metal.

D. Field oxygen cutting of structural steel for fitting-up purposes shall not be allowed.

E. Make all necessary provisions for temporary bracing and for completion of erection.

3.3 CONNECTIONS

A. Connections shall comply with requirements specified in Part 2 – Products.

B. No field splices shall be allowed.

3.4 TOLERANCES

A. Individual pieces shall be plumbed, leveled and aligned in accordance with the requirements specified herein.

B. Dimensions shown on Drawings are based on an assumed design temperature of 70 degrees F. Fabrication and erection procedures shall take into account the ambient temperature range at the time of the respective operations.

3.5 FIELD AND SHOP QUALITY CONTROL

A. Testing and inspection of structural steel will be performed by a testing agency retained by the Owner. Provide the testing agency with the following:

1. A complete set of accepted documents required under Paragraph "Submittals."

2. Cutting lists, order sheets, material bills, and shipping bills.

3. Information as to time and place of all rollings and shipment of material top shops.

4. Representative sample pieces as requested by the testing agency.

5. Full and ample means and assistance for testing all material.

6. Proper facilities, including scaffolding, temporary work platforms, etc., for inspection of the work in the mills, shop and filed.

B. Each person installing connections shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that the Inspector can refer back to the person making the connection. Welders must be AWS; copies of such shall be provided to the Testing Agency.

C. The Inspector will perform his duties, when possible, in such a way that fabrication and erection are not unnecessarily delayed or impeded, and as follows:

1. The Inspector shall make all tests and inspections as required by prevailing Codes and Ordinances. The Inspector shall make all the tests and inspections as may be indicated on the Structural Drawings.

2. The Inspector will make all tests and inspections as required by "Structural Welding Code."

3. The technique for radiographic inspection will be in accordance with Section 6, Part B of the "Structural Welding Code." A double film technique will be used. One copy of each film will be sent to the Architect, the other will be retained by the Inspector.

4. Ultrasonic inspection will be performed in accordance with Section 6, Part C of the "Structural Welding Code."

5. Shop welds will be inspected in the shop before the work is painted or approved for shipment.

6. The Inspector will make all tests and inspections of high strength bolt connections as required by AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts."

7. Where inspection reveals defects, the extent of inspection will be increased as much as necessary to assure that the full extent of the defects in a joint has been found and to assure that the same defects are not present on similar parts or under similar circumstances.

8. Work that is not acceptable will be designated by "Repair" or "Reject," as applicable.

9. The Inspector will maintain a daily record of the work he has inspected and its disposition. One copy of each of the reports will be submitted to the Architect on a weekly basis.

    a. Welding reports of tests will be made in form prescribed in the "Structural Welding Code."

AESS CATEGORY MATRIX

CATEGORY		AESS C	AESS 4	AESS 3	AESS 2	AESS 1	SSS
I.D.	CHARACTERISTICS	CUSTOM ELEMENTS	SHOWCASE ELEMENTS	FEATURE ELEMENTS IN CLOSE VIEW	FEATURE ELEMENTS NOT IN CLOSE VIEW	BASIC ELEMENTS	STANDARD STRUCTURAL STEEL
1.1	Surface preparation to SSPC-SP 6		×	×	×	×	
1.2	Sharp edges ground smooth		×	×	×	×	
1.3	Continuous weld appearance		×	×	×	×	
1.4	Standard structural bolts		×	×	×	×	
1.5	Weld spatters removed		×	×	×	×	
2.1	Visual Samples		×	×	optional		
2.2	One-half standard fabrication tolerances		×	×	×		
2.3	Fabrication marks not apparent		×	×	×		
2.4	Welds uniform and smooth		×	×	×		
3.1	Mill marks removed		×	×			
3.2	Butt and plug welds ground smooth and filled		×	×			
3.3	HSS weld seam oriented for reduced visibility		×	×			
3.4	Cross-sectional abutting surface aligned		×	×			
3.5	Joint gap tolerances minimized		×	×			
3.6	All welded connections		optional	optional			
4.1	HSS seam not apparent		×				
4.2	Welds contoured and blended		×				
4.3	Surfaces filled and sanded		×				
4.4	Weld show-through minimized		×				
C.1							

Table 10.1 found in the 2016 *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303-16).

END OF SECTION

SECTION 052100

STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. Long-span steel joists.
5. Joist accessories.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Division 04 Section "Unit Masonry" for installing bearing plates in unit masonry.

1.3 DEFINITIONS

A. SJI "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Sustainable Product Submittals:

1. For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and professional engineer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete construction.

1.9 MEASUREMENTS

A. Field Measurements: Obtain all field measurements required for proper fabrication and installation of work. Submit prior to installation, all measurements indicating discrepancies from the drawings. Describe in writing, and where applicable, by sketches proposed methods of correcting the discrepancies. Measurements are the responsibility of the contractor.

B. Lay out each part of the work in strict accordance with the architectural, structural, mechanical, electrical, plumbing and all other drawings and be responsible for correct location of the same. Lay out from at least two pre-established benchmarks and axis lines, individually correct for length and bearing.

C. Templates: Furnish templates and layout drawings for exact locations of items to be embedded in concrete, with setting instructions required for installation of embedded items.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

1. Use ASD; data are given at service-load level.
2. Design special joists to withstand design loads with live-load deflections no greater than the following:

a. Roof Joists: Vertical deflection of 1/360 of the span.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

2.2 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

D. Provide holes in chord members for connecting and securing other construction to joists.

E. Top-Chord Extensions: Extend top chords of joists with SJI's top-chord extensions where indicated, complying with SJI's "Specifications." Final top-chord extension type shall be as determined by the design provided by the joist manufacturer. Type S shall be provided for pricing.

F. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

G. Do not camber joists.

H. Camber joists according to SJI's "Specifications."

I. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.3 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.

1. Joist Type: DLH-series steel joists.
2. End Arrangement: Top chord bearing as indicated on plans.
3. Top-Chord Arrangement: Double Pitched, with extended ends as indicated on plans.
4. Bottom-Chord Arrangement: Bottom-chord extension (BCX) where indicated on plan. Design connection for worst-case design moment as indicated on drawings. Bottom chord shall not be extended and connected until dead load has been applied.
5. Top-Chord Extension: Top-chord extension (TCX) where indicated on plan. Design connection/bearing for worst-case design moment as indicated on drawings.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Camber long-span steel joists according to SJI's "Specifications.

E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.4 PRIMERS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.5 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal and/or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated.

C. Steel bearing plates with integral anchorages are specified in Division 05 Section "Metal Fabrications."

D. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface, unless otherwise indicated.

E. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.6 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply 1 coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Field welds will be visually inspected according to AWS D1.1/D1.1M.

C. In addition to visual inspection, field welds will be tested according to AWS D1.1/D1.1M and the following procedures, as applicable:

1. Radiographic Testing: ASTM E 94.
2. Magnetic Particle Inspection: ASTM E 709.
3. Ultrasonic Testing: ASTM E 164.
4. Liquid Penetrant Inspection: ASTM E 165.

D. Bolted connections will be visually inspected.

E. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

F. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

G. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel and accessories.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION

053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Roof deck.
   2. Composite Floor Deck

1.2 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATION SUBMITTALS

A. Product Certificates: For each type of steel deck, signed by product manufacturer.

B. Welding certificates.

C. Field quality-control test and inspection reports.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.

E. Research/Evaluation Reports: For steel deck.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those steel deck units tested for fire resistance per ASTM E 119 by a testing and inspection agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

E. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

F. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.6 MEASUREMENTS

A. Field Measurements: Obtain all field measurements required for proper fabrication and installation of work. Submit prior to installation, all measurements indicating discrepancies from the drawings. Describe in writing, and where applicable, by sketches proposed methods of correcting the discrepancies. Measurements are the responsibility of the contractor.

B. Lay out each part of the work in strict accordance with the architectural, structural, mechanical, electrical, plumbing and all other drawings and be responsible for correct location of the same. Lay out from at least two pre-established benchmarks and axis lines, individually correct for length and bearing.

C. Templates: Furnish templates and layout drawings for exact locations of items to be embedded in concrete, with setting instructions required for installation of embedded items.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 35 percent.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Canam United States; Canam Group Inc.
2. CMC Joist & Deck.
3. Consolidated Systems, Inc.; Metal Dek Group.
4. Epic Metals Corporation.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
9.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
2. Deck Profile: As indicated on the drawings.
3. Profile Depth: As indicated on the drawings; 1-1/2 inches (38 mm) minimum.
4. Design Uncoated-Steel Thickness: As indicated; 0.0358 inch (0.91 mm) minimum.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped or interlocking seam at Contractor's option and in coordination with deck manufacturer.

2.3 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Canam United States; Canam Group Inc.
2. CMC Joist & Deck.
3. Consolidated Systems, Inc.; Metal Dek Group.
4. Epic Metals Corporation.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
2. Profile Depth: As indicated on the drawings.
3. Design Uncoated-Steel Thickness: As indicated on the drawings; 0.0474 inch (1.20 mm).
4. Span Condition: Triple span or more.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

H. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

I. Galvanizing Repair Paint: ASTM A 780.

J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

K. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction [and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 150 g/L.
   3. Primers, Sealers, and Undercoaters: 200 g/L.
   4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
   5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
   1. Weld Diameter: 5/8 inch (16 mm), nominal.
   2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches (305 mm) apart in the field of roof and 6 inches (150 mm) apart in roof corners and perimeter, based on roof-area definitions in FMG Loss Prevention Data Sheet 1-28.
   3. Weld Washers: Install weld washers at each weld location as/if required based on deck gauge.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches (450 mm) and as follows:
   1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
   2. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
   1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches (305 mm) apart with at least one weld or fastener at each corner.
   1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
   1. Weld Diameter: 5/8 inch (16 mm), nominal.
   2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
   3. Weld Spacing: Space and locate welds as indicated.
   4. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (914 mm), and as follows:
   1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
   2. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
   1. End Joints: Lapped or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the cold-formed metal framing as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. "C" shaped steel studs for exterior non-load bearing wall frame construction.
2. "C" shaped steel joists.
3. Anchors and accessories.
4. Gypsum sheathing.
5. Field inspection.

1.3 RELATED SECTIONS

A. Structural Steel - Section 051200.

B. Thermal Insulation - Section 072100.

C. Vapor-Permeable Air Barrier Liquid Membrane - Section 072700.

D. Metal Wall Panels - Section 074213.

E. Gypsum Drywall - Section 092900, for interior steel stud construction.

1.4 QUALITY ASSURANCE

A. Component Design: Compute structural properties of studs in accordance with AISI "North American Specification for the Design of Cold Formed Steel Structural Members."

B. Fire-Rated Assemblies: Where framing units are indicated to be components of fire-resistance rated assemblies, provide cold formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspection agency acceptable to authorities having jurisdiction. Products used in the assembly shall carry a classification label from an approved testing and inspection agency.

C. Qualifications

1. Manufacturer's Qualifications: Minimum five years' experience in producing products of the type specified.

2. Installer's Qualifications: Minimum three years' experience in installation of the type of product specified.

3. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M "Structural Welding Code - Steel" and AWS DL3 "Structural Welding Code – Sheet Steel."

D. Pre-Installation Meeting

1. Convene meeting at project site within one week of scheduled start of installation with representatives of the following in attendance: Owner, Architect, General Contractor, and metal framing subcontractor.

2. Review substrate conditions, requirements of related work, installation instructions, storage and handling procedures, and protection measures.

3. Keep minutes of meeting, including responsibilities of various parties and deviations from specifications and installation instructions. Distribute minutes to attendees within 72 hours.

E. Comply with the following standards:

1. American Iron and Steel Institute (AISI):

   a. "North American Specification for the Design of Cold-Formed Steel Structural Members," latest edition.
   b. "Standard for Cold-Formed Steel Framing General Provisions."

2. American Welding Society (AWS):

   a. Structural Welding Code (D1.1).
   b. Specifications for Welding Sheet Steel in Structures (E1.3).

3. ASTM:

   a. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coted (Galvannealed) by the Hot-Dip Process.
   b. ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   c. ASTM A 924 - Standard Requirements for Sheet Steel, Metallic-Coated by the Hot-Dipped Process.
   d. ASTM C 955 – Standard Specification for Cold-Formed Structural Framing Members.
   e. ASTM A 1003 - Standard Specification for Steel Sheet, Carbon, Metallic- and Non-Metallic-Coated for Cold-Formed Framing Members.
   f. ASTM C 1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.

g. ASTM C 1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.

F. Vertical and Lateral Fire Propagation Test Characteristics: The exterior wall assembly is required to comply with NFPA 285 "Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components.' The base wall, stud cavity insulation, wall sheathing, air barrier, continuous wall rigid insulation and exterior cladding are components that are required to be to be evaluated as part of this specific assembly test. The basis of design product listed herein is a component of the design test assembly selected by the Architect.

1.5 SUBMITTALS

A. Product Data: For information only, submit copies of manufacturer's product information and installation instructions for each item of cold-formed framing and accessories.

B. Shop Drawings

1. Submit shop drawings for special components and installations not fully dimensioned or detailed in manufacturer's product data. Include placing drawings for framing members showing size and gauge designations, number, type, location and spacing. Indicate supplemental bracing, splices, window and door headers accessories and details as may be required for proper installation.

2. If the Contractor elects to prefabricate framing members into panels for erection, he shall submit shop drawings of such panels at suitable scale showing all dimensions, components, and methods of fastening and support.

C. For fasteners, submit product data sheet and samples.

D. Engineering Data

1. Submit Engineering Data drawings to the Architect for review. The Contractor is responsible for the structural design and supports for the cold-formed metal frame and must show his proposed system and how the Performance Criteria noted below is accommodated on these drawings.

2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of New Jersey and shall be signed and sealed by this Engineer.

E. Quality Assurance Submittals: Submit the following:

1. Qualifications: Proof of manufacturer and installer qualifications.

a. Member in good standing of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance.

b. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.

2. Structural design calculations.

3. Certificates

a. Submit mill certificates by framing member/accessory manufacturer certifying compliance with material requirements.
b. Welder certificates.

4. Manufacturer's installation instructions for framing members and framing accessories.

1.6 PERFORMANCE CRITERIA

A. Cold-formed metal framing system shall be designed, fabricated, and installed to withstand a 30 psf suction and pressure load (or greater if required by Code) with a maximum deflection of L/360 with metal panels.

B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100 and AISI S200 and ASTM C955, Section 8.

C. Design system to accommodate vertical deflection of structural building frame, live loading, seasonal and day/night temperature ranges and construction tolerances.

D. Comply with the International Building Code/2021, NJ ed., requirements for seismic connections and loads.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect metal framing units from rusting and damage. Deliver to one project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade. Store off the ground in a dry ventilated space or protect with suitable waterproof coverings. Conform to storage and handling requirements of AISI "Code of Standard Practice."

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Provide cold-formed steel framing manufactured by Marino/Ware, Superior Steel Studs, Clark Dietrich Building Systems, Super Stud Building Products, or approved equal.

2.2 METAL FRAMING, GENERAL

A. System Components: With each type of metal framing required, provide manufacturer's standard steel runners, (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners and accessories, as recommended by manufacturer for the applications indicated, as needed to provide a complete metal framing system.

2.3 MATERIALS

A. Steel Sheet for Studs and Tracks: ASTM A 1003 Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.

2. Coating: G90 galvanized coating.

B. Steel Sheet for Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.

2. Coating G90 galvanized coating.

2.4 FRAMING MEMBERS

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges; thickness and grade as required by structural performance.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths compatible with studs, un-punched, with un-stiffened flanges; thickness and grade as required by structural performance.

2.5 FRAMING ACCESSORIES

A. Stamp manufacturer's name on each accessory item.

B. Provide screws with accessories designated for screw attachment.

C. Connector Devices

1. Vertical Deflection Clips: "VertiClip," including step bushings, as manufactured by The Steel Network Inc. (919) 845-1025 or approved equal. Rigid attachments to structure and screw attachment to stud web using step-bushings to permit frictionless vertical movement. 68 mils minimum thickness, size as required by structural design calculations.

2. Rigid Clip Angles: "StiffClip" as manufactured by The Steel Network Inc., or approved equal, size as required by structural design calculations. Rigid attachment to structure and stud web.

D. Bridging

1. Cold Rolled Channel: 1-1/2" by ½" by 56 mil thick.

a. Bridging Clip: "BridgeClip" as manufactured by The Steel Network Inc. or approved equal. Provide attachment through stud punch-out clamping onto stud web and wrapping around bridging channel. Provide holes for screw attachment to stud web and channel.

2. Flat Strap: Width and thickness as required by structural design calculations. Rigid attachment to stud flange.

3. Solid Bridging: Channel shaped bridging with lipped flanges and integral formed clips. Screw attachment to stud. 33 mils minimum thickness, size as required by structural design calculations.

4. Bridging and accessories shall be hot dip zinc coated per ASTM A 153.

E. Header for Window and Door Openings: Provide "ProX Header" system made by Brady Innovations LLC, or approved equal complete with all accessories including clips and accessories; finish and gauge to match studs.

2.6 FASTENERS

A. Screws: Corrosion resistant coated, self-drilling, pan or hex washer head. Provide screw type and size as required by structural design calculations.

B. Anchor Bolts and Studs: ASTM A 307, Grade A, carbon steel, with hex-head carbon steel nuts and flat steel washers. Hot-dip zinc coated in accordance with ASTM A 153. Provide bolt or stud type and size as required by structural design calculations.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

2.7 GALVANIZING TOUCH-UP

A. For touching up damaged galvanized surfaces after erection, provide "Silver Galv" made by Z.R.C. Worldwide. Apply to a dry film thickness of 1.5 to 3.0 mils.

2.8 GYPSUM SHEATHING AND RELATED ACCESSORIES

A. Gypsum Sheathing: 5/8" thick "Dens-Glass Fireguard," Type X, made by Georgia Pacific, "Securock Glass-Mat Sheathing" made by U.S. Gypsum Co., "Gold Bond EXP Extended Exposure Sheathing" made by National Gypsum Co., "Weather Defense" made by Lafarge/Continental, or approved equal, meeting ASTM C 1177, Type X.

B. Fasteners: 1-1/4" Type S-12 screws "Climaseal" finish.

C. Joint Treatment: Provide a one-part high performance sealant conforming to ASTM C 920, Type S, Grade NS, Class 25 meeting with the approval of the air/vapor barrier manufacturer for compatibility; see Section 072700 for description. Apply a 3/8" bead of sealant to the joint and trowel flat. Apply enough of the same material to each fastener to cover completely when trowelled flat.

2.9 FABRICATION

A. Framing components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced against racking with joints welded. Perform lifting of prefabricated panels in a manner to prevent damage or distortion in any members in the assembly.

B. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting or screw fasteners, as standard with manufacturer.

C. Wire tying of framing components is not permitted.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where cold-formed metal framing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION, GENERAL

A. Methods of construction shall be piece by piece.

B. Connections shall be accomplished with self-drilling screws or welding so that the connection meets or exceeds the design loads required at that connection.

C. Studs shall be installed seated squarely (within 1/16") against the web portion of the top and bottom tracks. Tracks shall rest on a continuous, uniform bearing surface.

D. Cutting of steel framing members may be accomplished with a saw or shear. Torch cutting of loaded members is not permitted. Cutting of loaded members is not permitted unless under supervision of the project architect or engineer.

E. Temporary bracing shall be provided and left in place until work is permanently stabilized.

F. Bridging shall be of size and type shown on the approved shop drawings and as called for in the engineering calculations.

G. Install headers in all openings that are larger than the stud spacing in that wall. Form headers as shown on the drawings.

H. Insulation meeting the requirements of Section 072100 shall be placed in all jamb and header type conditions that will be inaccessible after their installation into the wall.

I. Provide jack studs to support each end of headers. These studs shall be securely connected to the header and must seat squarely in the lower track of the wall, and be properly attached to it.

J. If, by design, a header is low in the wall, the less than full-height studs (cripples) that occur over the header shall be designed to carry all imposed loads.

K. Wall track shall not be used support any load unless specifically designed for that purpose.

L. All axially loaded members shall be aligned vertically, to allow for full transfer of the loads down to the foundation. Vertical alignment shall be maintained at floor/wall intersections or alternate provisions for load transfer may be made.

M. Holes that are field cut into steel framing members shall be within the limitation of the product and its design. Provide reinforcement where holes are cut through load bearing members in accordance with manufacturer's recommendations and as approved by the Architect or Engineer.

N. Touch up all steel bared by welding using touch-up coating specified herein.

O. Studs shall be spaced to suit the design requirements and limitations of collateral facing materials.

P. Care should be taken to allow for additional studs at intersections, corners, doors, windows, control joints, etc., and as called for in the shop drawings or design calculations.

Q. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer’s recommendations and industry standards in each case, considering weight or loading resulting from item supported.

R. Provide for structure movement, expansion shall be allowed where indicated and necessary by design or code requirements.

S. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.

T. Install horizontal bridging in stud system, spaced (vertical distance) at not more than 48 inches on center. Fasten at each intersection.

U. Splicing of axially loaded members or floor joists shall not be permitted.

V. Wire tying of members is not permitted.

3.3 INSTALLATION OF GYPSUM SHEATHING

A. Fasten sheathing to exterior of each stud with specified fasteners spaced 3/8" from ends and edges and approx. 8" o.c. at each stud. Install fasteners in accordance with manufacturer’s recommendations using 2500-RPM maximum screw gun. Sheathing board shall be installed horizontally. Apply sealant between joints and trowel flush; and apply sealant around sheathing perimeter and at interface with other materials. Cover fastener heads with sealant and trowel flush.

B. Refer to Section 072700 for vapor permeable air barrier description.

END OF SECTION

SECTION 055000

MISCELLANEOUS METALS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the miscellaneous metal work as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Canopies.
2. Rough hardware.
3. Vertical steel ladders and ship's ladders.
4. Steel pipe handrails and railings not part of steel pan stair assemblies.
5. Loose steel lintels.
6. Light steel framing and supports not included as part of work of other trades.
7. Steel gratings and frames.
8. Steel plate covers and frames.
9. Structural steel door frames at service doors.
10. Cast thresholds.
11. Steel dunnage beams.
12. Steel bollards.
13. Miscellaneous steel trim, angle guards and channels.
14. Countertop supports.
15. Trench drains.
16. Masonry support steel.
17. Sleeves in concrete walls and slabs.

18. Steel framing, bracing, supports, anchors, bolts, shims, fastenings, and all other supplementary parts indicated on drawings or as required to complete each item of work of this Section.

19. Prime painting, touch-up painting, galvanizing and separation of dissimilar metals for work of this Section.

20. Cutting, fitting, drilling and tapping work of this Section to accommodate work of other Sections and of concrete, masonry or other materials as required for attaching and installing work of this Section.

1.3 RELATED SECTIONS

A. Structural Steel - Section 051200.

B. Steel Pan Stairs - Section 055113.

C. Column Covers - Section 055813.

D. Painting and Finishing - Section 099000.

1.4 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

B. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

C. Reference Standards: The work is subject to requirements of applicable portions of the following standards:

1. "Manual of Steel Construction," American Institute of Steel Construction.

2. AWS D1-1 "Structural Welding Code," American Welding Society.

3. SSPC SP-3 "Surface Preparation Specification No. 3, Power Tool Cleaning," Steel Structures Painting Council.

4. SSPC PA-1 "Painting Application Specification," Steel Structures Painting Council.

5. "Handbook on Bolt, Nut and Rivet Standards," Industrial Fasteners Institute.

D. Steel Materials: For steel to be hot dip-galvanized, provide steel chemically suitable for metal coatings complying with the following requirements: carbon below 0.25 percent, silicon below 0.24 percent, phosphorous below 0.05 percent, and manganese below 1.35 percent. Notify galvanizer if steel does not comply with these requirements to determine suitability for processing.

E. Engage the services of a galvanizer who has demonstrated a minimum of five (5) years' experience in the successful performance of the processes outlined in this specification

in the facility where the work is to be done and who will apply the galvanizing and coatings within the same facility as outlined herein. The Architect has the right to inspect and approve or reject the galvanizer/galvanizing facility.

F. The galvanizer/galvanizing facility must have an ongoing Quality Control/Quality Assurance program which has been in effect for a minimum of five years and shall provide the Architect with process and final inspection documentation. The galvanizer/galvanizing facility must have an on-premise testing facility capable of measuring the chemical and metallurgical composition of the galvanizing bath and pickling tanks.

G. Inspection and testing of hot-dip galvanized coating shall be done under the guidelines provided in the American Hot-Dip Galvanizers Association (AGA) publication "Inspection of Products Hot-Dip Galvanized After Fabrication."

1.5 PERFORMANCE STANDARDS

A. Railings shall be designed to resist loads per the International Building Code/2021, NJ ed.

1.6 SUBMITTALS

A. Manufacturer's Literature: Submit manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in the fabrication of miscellaneous metal work, including paint products.

B. Shop Drawings: Shop drawings for the fabrication and erection of all assemblies of miscellaneous iron work which are not completely shown by manufacturer's data sheets. Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1'-0" scale. Show anchorage and accessory items.

C. Engineering Data

1. Before any ladders or railings are fabricated, submit engineering data drawings to the Architect for review indicating how performance standards specified here shall be met. The Contractor is responsible for the structural design and supports for these systems and must show his proposed systems on these drawings.

2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of New Jersey and shall be signed and sealed by this Engineer.

D. Welding shall be indicated on shop drawings using AWS symbols and showing length, size and spacing (if not continuous). Auxiliary views shall be shown to clarify all welding. Notes such as 1/4" weld, weld and tack weld are not acceptable.

E. Certification: For items to be hot-dip galvanized, identify each item galvanized and to show compliance of application. The Certificate shall be signed by the galvanizer and shall contain a detailed description of the material processed and the ASTM standard used for the coating and, the weight of the coating. In addition, and as attachment to

Certification, submit reports of testing and inspections indicating compliance with the provisions of this Section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Metals

1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.

2. Steel Plates, Shapes and Bars: ASTM A 36.

3. Steel Bar Grating: ASTM A 1011 or ASTM A 36.

4. Steel Tubing: Cold formed, ASTM A 500; or hot rolled, ASTM A 501.

5. Structural Steel Sheet: Hot rolled, ASTM A 1011; or cold rolled, ASTM A 1008, Class 1; of grade required for design loading.

6. Galvanized Structural Steel Sheet: ASTM A 924, of grade required for design loading. Coating designation G90.

7. Steel Pipe: ASTM A 53, type and grade as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (Schedule 40), unless otherwise indicated.

8. Gray Iron Castings: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.

9. Malleable Iron Castings: ASTM A 47, grade as selected by fabricator.

10. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

11. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A 153.

B. Grout: Non-shrink, non-metallic grout conforming to the requirements of Section 033000.

C. Fasteners

1. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.

2. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.

3. Anchor Bolts: ASTM F 1554, Grade 36.

4. Lag Bolts: ASME B18.2.1.

5. Machine Screws: ASME B18.6.3.

6. Plain Washers: Round, carbon steel, ASME B18.22.1.

7. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.

8. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and style as required.

9. Lock Washers: Helical spring type carbon steel, ASME B18.21.1.

D. Shop Paint: Shop prime all non-galvanized miscellaneous metal items using Series 88 Azeron Primer made by Tnemec, ICI Devoe "Rust Guard" quick dry alkyd shop coat No. 41403, or "Interlac 393" by International Protection Coatings.

1. If steel is to receive high performance coating as noted in Section 099000, shop prime using primer noted in Section 099000.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Galvanizing Repair Coating: For touching up galvanized surfaces after erection, provide repair coating that is V.O.C. compliant, equal to "Silver Galv" made by Z.R.C. Worldwide or approved equal. Apply to a dry film thickness of 1.5 to 3.0 mils.

2.2 PRIME PAINTING

A. Scope: All ferrous metal (except galvanized steel) shall be cleaned and shop painted with one coat of specified ferrous metal primer. No shop prime paint required on galvanized steel or aluminum work.

B. Cleaning: Conform to Steel Structures Painting Council Surface Preparation Specification SP 3 (latest edition) "Power Tool Cleaning" for cleaning of ferrous metals which are to receive shop prime coat.

1. Steel to get high performance coating as noted in Section 099000 shall be cleaned as per SSPC SP.6 "Commercial Blast Cleaning."

C. Application

1. Apply shop prime coat immediately after cleaning metal. Apply paint in dry weather or under cover. Metal surfaces shall be free from frost or moisture when painted. Paint all metal surfaces including edges, joints, holes, corners, etc.

2. Paint surfaces which will be concealed after shop assembly prior to such assembly. Apply paint in accordance with approved paint manufacturer's printed instructions, and the use of any thinners, adulterants or admixtures shall be only as stated in said instructions.

3. Paint shall uniformly and completely cover the metal surfaces, 2.0 mils minimum dry film thickness. No work shall be shipped until the shop prime coat thereon has dried.

D. Touch-Up: In the shop, after assembly and in the field, after installation of work of this Section, touch-up damaged or abraded portions of shop prime paint with specified ferrous metal primer.

E. Apply one shop coat to fabricated metal items, except apply two (2) coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

2.3 GALVANIZING

A. Scope: All ferrous metal exposed to the weather, and all ferrous metals indicated on drawings or in specifications to be galvanized, shall be cleaned and then hot-dipped galvanized after fabrication as provided by Duncan Galvanizing or approved equal.

B. Avoid fabrication techniques that could cause distortion or embrittlement of steel items to be hot-dip galvanized. Fabricator shall consult with hot-dip galvanizer regarding potential warpage problems or handling problems during the galvanizing process that may require adjustment of fabrication techniques or design before finalizing shop drawings and beginning of fabrication.

C. Cleaning: Thoroughly clean metal surfaces of all mill scale, rust, dirt, grease, oil, moisture and other contaminants prior to galvanizing.

D. Application: Hot-dip galvanizing shall conform to the following:

1. ASTM A 143: Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel.

2. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

3. ASTM A 153: Galvanized Coating on Iron and Steel Hardware - Table 1.

4. ASTM A 384: Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

5. ASTM A 385: Practice for Providing High Quality Zinc Coatings.

6. ASTM A 924: Galvanized Coating on Steel Sheets.

7. Minimum weight of galvanized coating shall be two (2) oz. per square foot of surface.

E. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

F. All galvanized materials must be inspected for compliance with these specifications and marked with a stamp indicating the name of the galvanizer, the weight of the coating, and the appropriate ASTM number.

G. To minimize surface imperfection (e.g.: flux inclusions), material to be galvanized shall be dipped into a solution of Zinc Ammonium Chloride (pre-flux) immediately prior to galvanizing. The type of galvanizing process utilizing a flux blanket overlaying the molten zinc will not be permitted.

H. After galvanizing all materials not exposed to view must be chromated by dipping material in a 0.2% chromic acid solution.

I. Galvanized surfaces, where exposed to view, must have a smooth, level surface finish. Where this does not occur, piece shall be rejected and replaced to the acceptance of the Architect.

2.4 PROTECTIVE COATINGS

A. Whenever dissimilar metals will be in contact, separate contact surfaces by coating each contact surface prior to assembly or installation with one coat of specified bituminous paint, which shall be in addition to the specified shop prime paint. Mask off those surfaces not required to receive protective coating.

2.5 WORKMANSHIP

A. General

1. Miscellaneous metal work shall be fabricated by an experienced fabricator or manufacturer and installed by an experienced tradesman.

2. Materials, methods of fabrication, fitting, assembly, bracing, supporting, fastening, operating devices, and erection shall be in accordance with drawings and specifications, approved shop drawings, and best practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected.

3. All work shall be accurately and neatly fabricated, assembled and erected.

B. Shop Assembly: Insofar as practicable, fitting and assembly of work shall be done in shop. Shop assemble work in largest practical sizes to minimize field work. It is the responsibility of the miscellaneous metal subcontractor to assure himself that the shop-fabricated miscellaneous metal items will properly fit the field condition. In the event that shop-fabricated miscellaneous metal items do not fit the field condition, the item shall be returned to the shop for correction.

C. Cutting: Cut metal by sawing, shearing, or blanking. Flame cutting will be permitted only if cut edges are ground back to clean, smooth edges. Make cuts accurate, clean, sharp and free of burrs, without deforming adjacent surfaces or metals.

D. Holes: Drill or cleanly punch holes; do not burn.

E. Connections: Make connections with tight joints, capable of developing full strength of member, flush unless indicated otherwise, formed to exclude water where exposed to weather. Locate joints where least conspicuous. Unless indicated otherwise, weld or bolt shop connections; bolt or screw field connections. Provide expansion and contraction joints to allow for thermal movement of metal at locations and by methods approved by Architect.

1. Welding

a. Shall be in accordance with AWS D1.1 Structural Welding Code of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturer of the metals being welded.
b. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth with and to match finish of adjoining surfaces; undercut metal edges where welds are required to be flush.
c. All welds on or behind surfaces which will be exposed to view shall be done so as to prevent distortion of finished surface. Remove weld spatter and welding oxides from all welded surfaces.

2. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts. Bolts and screw heads exposed to view shall be flat and countersunk. Cut off projecting ends of exposed bolts and screws flush with nuts or adjacent metal.

F. Operating Mechanism: Operating devices (i.e. pivots, hinges, etc.) mechanism and hardware used in connection with this work shall be fabricated, assembled, installed and adjusted after installation so that they will operate smoothly, freely, noiselessly and without excessive friction.

G. Built-In Work: Furnish anchor bolts, inserts, plates and any other anchorage devices, and all other items specified under this Section of the Specifications to be built into concrete, masonry or work of other trades, with necessary templates and instructions, and in ample time to facilitate proper placing and installation.

H. Supplementary Parts: Provide as necessary to complete each item of work, even though such supplementary parts are not shown or specified.

I. Coordination: Accurately cut, fit, drill and tap work of this Section to accommodate and fit work of other trades. Furnish or obtain, as applicable, templates and drawings to or from applicable trades for proper coordination of this work.

J. Exposed Work

1. In addition to requirements specified herein and shown on drawings, all surfaces exposed to view shall be clean and free from dirt, stains, grease, scratches, distortions, waves, dents, buckles, tool marks, burrs, and other defects which mar appearance of finished work.

2. Metal work exposed to view shall be straight and true to line or curve, smooth arrises and angles as sharp as practicable, miters formed in true alignment, profiles accurately intersecting, and with joints carefully matched to produce continuity of line and design.

3. Exposed fastenings, where permitted, shall be of the same material, color and finish as the metal to which applied, unless otherwise indicated, and shall be of the smallest practicable size.

K. Preparation for Hot-Dip Galvanizing: Fabricator shall correctly prepare assemblies for galvanizing in consultation with galvanizer and in accordance with applicable Reference Standards and applicable AGA publications for the "Design of Products to be

Hot-Dip galvanized After Fabrication." Preparation shall include but not be limited to the following:

1. Remove welding flux.

2. Drill appropriate vent holes and provide for drainage in inconspicuous locations of hollow sections and semi-enclosed elements. After galvanizing, plug vent holes with shaped lead and grind smooth.

2.6 MISCELLANEOUS METALS ITEMS

A. Rough Hardware

1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 Sections.

2. Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood connections; elsewhere, furnish steel washers.

B. Ladders

1. Vertical steel ladders shall be eighteen (18) inches wide with 3/4" diameter non-slip steel rungs spaced twelve (12) inches o.c. Stringers shall be 3/8" thick by 2-1/2" wide steel bars; rungs welded to bars. Attach ladders to walls six (6) inches from top and bottom and maximum thirty-six (36) inches o.c. from these points. At the roof, gooseneck the rails back to the structure to provide secure ladder access.

2. Provide sloping ladders (ship's ladders) where noted. Fabricate open type construction with structural steel channel or steel plate stringers, pipe handrails, and open steel grating treads. Provide all necessary brackets and fittings for installation.

3. Ladders shall be fabricated to support a live load of one hundred (100) lbs. per square foot and a concentrated load of three hundred (300) lbs. per rung; loads not to act simultaneously.

C. Steel Pipe Handrails: Provide Schedule 40 steel pipe of size shown on Drawings. Fittings shall be flush type, malleable of cast iron. Brackets shall be malleable iron, design as selected by the Architect.

1. Construction: Form direction changes in rails using solid bar stock or elbows. Connections shall be shop welded and ground smooth and flush, except where field connections and expansion joints are required. Field connections may be welded, internal sleeve and plug weld, or internal sleeve and set screw.

2. Secure handrails to walls with wall brackets. Provide brackets of malleable iron castings, with not more than three (3) inches clearance from inside face of handrail to wall surface. Neatly drill wall plate portion of the bracket into concrete or masonry to receive bolts for concealed anchorage. For installation at drywall,

Drywall trades shall provide plate to receive wall plate portion of bracket and anchor or bolt wall plate through drywall to supporting steel plate. Locate brackets at not more than 5'-0" o.c. unless otherwise shown.

3. Provide wall return fittings of cast iron, flush type, with the same projection as that specified for wall brackets.

4. Longitudinal members shall be parallel with each other and with floor surface or shape of stair to a tolerance of 1/8" in 10'-0" linear feet. Center line of members within each run of railing shall be in the plane.

5. For steel pipe posts where indicated, anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized steel pipe, not less than six (6) inches long and having an inside diameter not less than 1/2" greater than outside diameter of the inserted pipe. Provide steel plate closure secure to bottom of sleeve and of width and length not less than one (1) inch greater than outside diameter of sleeve. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-shrink, non-ferrous grout. Cover anchorage joint with a round steel flange welded to post. Posts shall be set plumb within 1/8" vertical tolerance.

6. Steel pipe handrails shall be capable of resisting a two hundred (200) lb. force applied to rail from any direction and a uniformly distributed load of fifty (50) lbs. per linear foot applied downward or horizontally, loads not to act simultaneously.

D. Loose Steel Lintels: Provide loose structural steel lintels for openings and recesses in masonry walls and partitions as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than eight (8) inches bearing at each side of openings, unless otherwise indicated.

1. Loose lintels shall conform to the following Schedule:

Opening Width (Maximum)	**WALL THICKNESS**		
	4 inches	6 inches	8 inches*
2'-0"	3-1/2" x 3-1/2" x 1/4"	6" x 4" x 5/16"	3-1/2" x 3-1/2" x 1/4"
3'-0"	3-1/2" x 3-1/2" x 5/16"	6" x 4" x 5/16"	3-1/2" x 3-1/2" x 5/16"
4'-0"	3-1/2" x 3-1/2" x 5/16"	6" x 4" x 5/16"	3-1/2" x 3-1/2" x 5/16"
5'-0"	4" x 3-1/2" x 3/8"	6" x 4" x 3/8"	4" x 3-1/2" x 5/16"
6'-0"	5" x 3-1/2" x 3/8"	6" x 4" x 3/8"	5" x 3-1/2" x 5/16"
7'-0"	5" x 3-1/2" x 3/8"	5" x 5" x 1/2"	5" x 3-1/2" x 3/8"
8'-0"	5" x 3-1/2" x 3/8"	5" x 5" x 5/8"	5" x 3-1/2" x 3/8"

* Two angles at all openings in eight (8) inch walls.

2. At columns or vertical surfaces where lintels cannot bear on masonry, provide clip angles sized for structural capacity of lintel.

E. Miscellaneous Light Steel Framing

1. Light steel framing, bracing, supports, framing, clip angles, shelf angles, plates, etc., shall be of such shapes and sizes as indicated on the drawings and details or as required to suit the condition and shall be provided with all necessary supports and reinforcing such as hangers, braces, struts, clip angles, anchors, bolts, nuts, welds, etc., as required to properly support and rigidly fasten and anchor same in place and to steel, concrete, masonry and all other connecting and adjoining work.

2. All light steel framing steel shall be furnished and erected in accordance with the applicable requirements of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" by the American Institute of Steel Construction and as specified herein.

F. Steel Gratings and Frames: Provide hot dipped galvanized steel gratings with rectangular cross bars welded to bearing bars. Bars to have plain wearing surface.

1. Manufacturer: Provide gratings manufactured by McNichols, IKG, Ohio Gratings, or approved equal.

2. Hinged Section: Provide hinged sections in areaway gratings where required by the drawings. Each hinged section up to 4'-0" wide shall be provided with two (2) five knuckle, fast pin, regular weight, plain bearing, wrought bronze butt hinges. Each hinged section over 4'-0" wide shall be provided with three (3) butt hinges. Hinged sections shall have provisions for padlocking on the underside.

3. Furnish grating frames, with corners mitered, welded and ground smooth, and with welded-on straps for secure anchorage into concrete. Frames and anchors to be galvanized.

4. Structural Performance: Provide gratings capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections:

a. Floors: Capable of withstanding a uniform load of 250 lbf/sq. ft. or a concentrated load of 3000 lbf, whichever produces the greater stress.
b. Walkways and Elevated Platforms Other Than Exits: Capable of withstanding a uniform load of 60 lbf/sq. ft. Limit deflection to L/360 or 1/4", whichever is less.
c. Walkways and Elevated Platforms Used as Exits: Capable of withstanding a uniform of 100 lbf/sq. ft. or a concentrated load of 300 lbf on an area of 4 sq. in., whichever produces the greater stress. Limit deflection to L/360 or 1/4", whichever is less.
d. Sidewalks and Vehicular Driveways: Capable of withstanding a uniform load of 250 lbf/sq. ft. or a concentrated load of 8000 lbf, whichever produces the greater stress.

G. Pit Covers and Frames: Provide minimum 1/2" thick steel checkered plate cover, reinforced as required to limit deflection to 1/360 of span, with two (2) recessed lifting handles capable of supporting five hundred (500) lbs. each. Furnish covers with steel angle frames, with corners mitered, welded and ground smooth, and with welded-on straps for secure anchorage into concrete. Frames and anchors to be galvanized. Plate covers shall be capable of supporting same loads as adjacent floor surfaces.

H. Structural Steel Door Frames

1. Fabricate steel door frames of structural shapes and bars, fully welded, uniform, square and true. Plug weld built-up members, continuously weld exposed joints; grind exposed welds smooth. Provide 5/8" x 1-1/2" steel bar stops. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than ten (10) inches o.c.

2. Provide necessary reinforcements and drill and tap as required for finish hardware.

3. Provide steel strap anchors for securing door frames into adjoining concrete or masonry, using 1/8" x 2" straps of the length required for a minimum eight (8) inch embedment. Weld anchors to frame jambs no more than twelve (12) inches from both bottom and head of frame and space anchors not more than thirty (30) inches apart.

4. Extend bottom of frames to floor elevation and secure to concrete with steel angle clips welded to frames, anchored with expansion shields and bolts.

I. Cast Thresholds

1. Fabricate of sizes and configurations as shown. Provide cast iron units with integral abrasive finish. Furnish in lengths as required to accurately fit each opening or condition.

   a. Cast units with an integral abrasive grit consisting of aluminum oxide, silicone carbide, or a combination of both.

2. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

   a. Provide two (2) rows of holes for units over five (5) inches wide, with two (2) holes aligned at ends and staggered intermediate holes.

3. Apply black asphaltic coating to concealed bottoms, sides and edges of cast iron units set into concrete.

4. Provide a diamond surface texture.

J. Steel Bollards: Provide six (6) inches O.D. extra strong (Schedule 80) steel pipe, concrete filled, with base of steel plate for mounting to anchor bolts in concrete foundation. Rabbet top of steel pipe and insert 1/4" steel plate cap, flush with top of pipe. Weld top of cap to pipe and grind smooth and flush.

K. Miscellaneous Steel Trim: Provide shapes and sizes for profiles shown. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel

bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.

L. Countertop Supports: Steel framing as indicated or required to support countertops. Conceal framing under countertops and within wall behind countertops. Provide supports to withstand a concentrated load of not less than three hundred (300) lbs. applied at any point with a deflection not to exceed L/240 for the length of the countertop.

M. Trench Drains: Provide Series R-4999 trench frame with Type A grated cover, heavy duty, made of ductile iron as manufactured by Neenah Foundry Co., or approved equal, sizes as shown on drawings. Assembly shall have asphalt coating. Grate shall be bolted in place with stainless steel hex head cap screws.

N. Masonry Support Steel

1. Provide galvanized steel, relieving angles, plates, accessories and other steel shapes for masonry support steel; for lintels refer to Para. D. herein.

2. Fabricate masonry support steel to allow final adjustment with the closest tolerances possible. Relieving angles which require cutting to fit masonry flashing shall be straightened without deflections.

3. Coordinate masonry support system with concrete work for locations of wedge inserts.

4. Install to meet requirements of building masonry work, face brick coursing and stone placement. Coordinate final adjustments with masonry work as work progresses.

O. Sleeves in Concrete Walls and Slabs

1. Sleeves through concrete walls shall be of Schedule 40 steel pipe with i.d. two (2) inches larger than o.d. of pipe or conduit (including insulation, if any) to be accommodated. Sleeves shall project one-half (1/2) inch on each side of finished wall. Provide rectangular one-quarter (1/4) inch steel plate collar at center, continuously welded to the perimeter of the sleeve, and six (6) inches wider than the o.d.

2. Slots in slabs shall be 12 gauge steel sheet, galvanized, of dimensions indicated, with strap anchors welded in place not more than twelve (12) inches on centers.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where miscellaneous metal is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 ERECTION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry, or similar construction.

C. Fitting Connections: Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance, and quality of welds made, and methods used in correcting welding work.

E. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

F. Field Touch-Up of Galvanized Surfaces: Touch-up shop applied galvanized coatings damaged during handling and installation. Use galvanizing repair coating specified herein for galvanized surfaces.

END OF SECTION

SECTION 055113

STEEL PAN STAIRS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the steel pan stairs as indicated on the drawings and specified herein, including but not limited to, the following:

1. Steel pan stairs, including all clips, hangers, inserts, braces and other supports.

2. Steel pipe handrails, guardrails, and intermediate rails for steel stairs, including supports, brackets, and anchors.

1.3 RELATED SECTIONS

A. Structural Steel - Section 051200.

B. Miscellaneous Metals - Section 055000.

C. Gypsum Drywall - Section 092900, for installation of inserts in drywall furnished by this Section.

D. Resilient Base and Accessories - Section 096513, for resilient stair treads.

E. Painting and Finishing - Section 099000.

1.4 QUALITY ASSURANCE

A. Qualification of Welders: Use only certified welders and the shielded arc process for all welding performed in connection with the work of this Section. Protect adjacent surfaces when field welding to prevent damage or stain. Welders and welding operators must be qualified by tests as provided by AWS.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with:

1. "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.

2. "Code for Welding in Building Construction" of the American Welding Society.

3. "Metal Stairs Manual" of the National Association of Architectural Metal Manufacturers.

C. Conflicting Requirements: In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards of these specifications, the provisions of the more stringent shall govern.

D. Field Measurements: If construction process permits, take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress. Allow for trimming and fitting wherever taking field measurements before fabrication might delay work.

E. Tolerances: Allow for construction tolerances as required.

F. Coordination: Coordinate this work with the work of all other trades interfacing with metal pan stairs, such as structural openings, sprinklers and standpipes, and other trades as required.

1.5 DRAWING SUBMISSION

A. General: It is the intent of the Working Drawings to display the layouts and general design parameters upon which the Shop Drawings shall be developed. Detail development and all connections shall be part of Shop Drawing Development.

B. Shop Drawings

1. Before any steel stairs are fabricated, submit shop drawings to the Architect for approval.

2. Show all locations, markings, quantities, materials, sizes and shapes, and indicate all methods of connecting, anchoring, fastening, bracing, for the stair construction, support and attachment to the work of other trades.

C. Engineering Data

1. Before any metal pan stairs are fabricated, submit engineering data drawings to the Architect for review. The Contractor is responsible for the structural design and supports for the stair system and must show his proposed system on these drawings.

2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of stair members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of New Jersey and shall be signed and sealed by this Engineer.

1.6 SAMPLES SUBMISSION

A. Submit the following listed samples and other samples as may be requested by the Architect, to show the quality standards:

1. Railing bracket.

2. Exposed weld.

3. Exposed bolted connection.

4. Bent pipe railing.

B. Samples shall be submitted cleaned and shop primed and shall represent standards to which all respective materials used in the Project shall meet.

1.7 PERFORMANCE STANDARDS

A. Stairs and railings shall be constructed to conform to the following performance standards, unless greater required by the International Building Code/2021, NJ ed.:

1. Stairs and platforms shall support a live load of one hundred (100) psf and a concentrated live load of three hundred (300) lbs. and shall have a live load deflection limited to 1/360 of the span. Loads shall not apply simultaneously.

2. Loads of Handrails and Guards

a. Handrails and guards shall be designed to resist a load of 50 pounds per lineal foot applied in any direction at the top and to transfer this load through the supports to the structure supporting the rail or guard.
b. Handrail assemblies shall also be able to resist a single concentrated load of 200 pounds applied in any direction at any point along the top. This load can be considered independently of the uniform load noted previously.
c. Intermediate rails, that is, those not the handrail, shall be able to resist a load of 50 pounds on an area not to exceed 1 sf including the openings and spaces between rails. These are not required to be superimposed with the other railing loads noted above.

1.8 PRODUCT HANDLING

A. Protection: Use all means necessary to protect steel pan stair before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Steel: ASTM A 36.

B. Steel Sheets: ASTM A 245, Grade C, minimum ten (10) gauge for platforms, twelve (12) gauge minimum for treads and risers.

C. Steel Pipe: ASTM A 53, Type E., Grade A, and ASTM A 501. Use standard malleable iron fittings for steel pipe.

D. Malleable Iron Castings: ASTM A 47, Grade 35018.

E. Bolts and Nuts: ASTM A 307, Grade A bolts.

F. Machine Screws: ASME B 18.6.3.

G. Expansion Bolts: "Cinch" type, galvanized, of approved manufacture.

H. Threaded End Hanger Rods: Minimum 3/4" diameter, ASTM A 36.

I. Shop Paint: Shop prime all stairs and railings using Series 88 Azeron Primer made by Tnemec, ICI Devoe "Rust Guard" quick dry alkyd shop coat No. 41403, or "Interlac 393" by International Protection Coatings.

J. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D1187.

K. Concrete Fill and Reinforcing Materials

1. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 3000 psi.

2. Nonslip-Aggregate Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

a. Where resilient stair treads are indicated, concrete shall have a trowel finish.

3. Welded Wire Fabric: ASTM A 185, 6 by 6 inches – W1.4 by W1.4, unless otherwise indicated.

2.2 FABRICATION

A. General

1. Steel pan stair work shall be fabricated by an experienced manufacturer in accordance with approved shop drawings and best practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand strains and stresses to which material will be subjected.

2. Fabricate shop assemblies in largest practical sizes to minimize field work. All exposed surfaces shall be clean and free from all dirt, stains, grease marks, scratches, waves, dents, buckles, tool marks, rattles, and other objectionable defects which mar appearance or use of finished work.

3. Cutting: Cut materials by sawing, shearing, or blanking. Flame cutting will be permitted when ground back to clean edges. Cuts shall be made accurately, clean, sharp and free of burrs, without deforming adjacent metals.

4. Connections: Make connections with tight joints, capable of developing full strength of the members, flush. Locate joints where least conspicuous. Use concealed fasteners where possible. Weld or rivet shop connections; bolt, screw or weld field connections.

a. Welding: Welds shall be continuous, except where spot welding is specifically permitted. Welding shall conform to the Standard Code of the American Welding Society. Exposed welds are required to be ground flush.
b. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts, or upset thread ends. Exposed bolts and screw head shall be flat and countersunk, unless otherwise indicated on drawings. Remove projecting ends of bolts and screws. Punch or drill holes; do not burn.

B. Stairs and Platforms

1. Provide stringers, risers, sub-treads and platforms matching profiles as shown. Form tread pan and riser in a continuous piece to receive the finished tread; tread shall be a minimum of twelve (12) gauge. Weld risers and treads to carrier angles which shall be welded to the structural steel stringers. Fasten countersunk bolts or stud welded clips through mesh for cement fill. Provide welded-on clips for the support of gypsum drywall soffits.

2. On intermediate platforms, provide metal bases formed of stringers. Miter and weld and grind smooth internal and external corners of metal bases. Form platform runs of minimum ten (10) gauge steel.

3. Countersink bolt heads and screws on finished surfaces or cut off flush with such surfaces.

4. Properly fit and securely fasten together all parts making exposed joints close fitting. Cut, drill, punch and tap as required for installation.

5. Make joints as strong and rigid as adjoining sections. Weld continuously along entire line of contact except where spot welding is indicated.

6. Separate dissimilar metals in or adjacent to work of this Section with a coat of bituminous paint on each surface prior to installation.

7. Closure and Filler Plates: Where indicated on drawings or as required, at least twelve (12) gauge sheet steel, securely fastened to top and bottom of stringer and adjacent wall, by welding or screws.

8. Struts, Hangers, Platform Headers and Subframing

   a. Provide supports as detailed and required, including all struts, clip angles, angles or hangers which are required and necessary for support of stair construction.
   b. Supports shall be of size suitable for the support load, as required. Struts, angles and hangers shall be supported by and directly connected to the structural framing. Struts and hangers, with their connections, shall be concealed.
   c. Provide other inserts, anchors and/or other subframing as may be required to complete the stair construction and properly support it on the structural framing.

C. Handrails, Railings, Posts and Brackets

1. Provide steel pipe of size shown on drawings, Schedule 40. Use heavier weight pipes and/or reinforce pipes internally as required to meet performance standards given in paragraph 1.7 herein. Fittings shall be flush type, malleable or cast iron. Wall brackets shall be steel design as detailed.

2. Handrail, post and railing spacing shall meet Code requirements.

3. Construction: Form direction changes in rails using solid bar stock or elbows. Connections shall be shop welded, except where expansion joints are required.

Field connections shall be welded for continuity. All exposed welds shall be ground smooth and flush.

a. If elbows are not available for angles shown, bends shall maintain full diameter of pipe, use mandrel, no kinks, ripples, flats are acceptable.

4. Fabricate newel or steel tubing with wall thickness of 0.120" and provide gray iron casting newel caps.

5. Anchor posts to steel with steel flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.

6. Secure handrails to walls with wall brackets. Provide brackets as shown on drawings. For installation in drywall, furnish Drywall Section steel plate to receive wall plate portion of bracket and anchor or bolt wall plate through drywall to supporting steel plate. Locate brackets at not more than 5'-0" o.c. unless otherwise shown.

7. Anchor rail ends into adjacent walls with steel flanges welded to rail ends and anchored into the wall construction as described above.

2.3 SHOP PAINTING

A. Scope: All ferrous metal shall be cleaned and shop painted with one coat of specified ferrous metal primer.

B. Cleaning: Conform to Steel Structures Painting Council Surface Preparation Specification SP 3 (latest edition) "Power Tool Cleaning" for cleaning of ferrous metals which are to receive shop prime coat.

C. Application

1. Apply shop prime coat immediately after cleaning metal. Apply paint in dry weather or under cover. Metal surfaces shall be free from frost or moisture when painted. Paint all metal surfaces including edges, joints, holes, corners, etc.

2. Paint surfaces which will be concealed after shop assembly prior to such assembly. Apply paint in accordance with approved paint manufacturer's printed instructions, and the use of any thinners, adulterants or admixtures shall be only as stated in said instructions.

3. Paint shall uniformly and completely cover the metal surfaces, 2.0 mils minimum dry film thickness. No work shall be shipped until the shop prime coat thereon has dried.

D. Touch-Up: In the shop, after assembly and in the field, after installation of work of this Section, touch-up damaged or abraded portions of shop prime paint with specified ferrous metal primer.

E. Apply one shop coat to fabricated metal items, except apply two (2) coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where steel pan stairs are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Work in the field shall comply with the same requirements as specified for shop work above.

B. Except where otherwise shown or specified for a particular item of work or for built-in work, fasten metal work to solid masonry with expansion bolts. Fastenings to wood plugs in masonry will not be accepted. Drill holes to the exact diameter of the bolts using a rotary drill for concrete and a percussion drill for other masonry. Thread screws full length to the head of the screw.

C. Provide connecting members needed for properly securing the work to masonry, drywall and structural framing, including bolts, machine screws, rods, hangers, inserts, sleeves, plates, anchors, expansion bolts, washers and other items as required. Furnish built-in items to drywall trades as required for proper anchorage.

D. Leave work exposed to view, including stair soffits, clean, smooth and neatly finished. All exposed welds shall be dressed smooth.

E. Include supplementary parts necessary to complete each item even though such work is not definitively shown or specified.

F. Coordinate and schedule the work of this Section with the work of other trades. Furnish anchors, sockets, fastenings and other miscellaneous items to be embedded in concrete or masonry, or required for securing metal work to other construction so as not to delay job progress.

G. Attach wall railings to the wall construction, using appropriate bolts and anchors to meet performance standards.

H. Install work plumb and true to the exact lines and levels, in the correct location and in proper relation to adjoining work.

I. Touch up marred and abraded shop paint of exposed surfaces after erection in the field.

J. Posts shall be set plumb within 1/8" vertical tolerance. Longitudinal members shall be parallel with each other and with floor surface or slope of stair to a tolerance of 1/8" in ten (10) linear feet. Center lines of members within each run of railing shall lie in the same vertical plane. Field joints of connecting sections shall be hairline.

3.3 TOUCH-UP PAINTING

A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop coat, and paint exposed areas with same material used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

END OF SECTION

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum pipe railings.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Pipe and Tube Railings:

1. Pisor Industries, Inc.
2. Wagner, R&B, Inc.; a division of the Wagner Companies
3. Summit Tube, Inc.
4. Hofmann Industries, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

    a. Uniform load of 50 lbf/ ft. applied in any direction.
    b. Concentrated load of 200 lbf applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

    a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52.

2.5 FASTENERS

A. General: Provide the following:
    1. Aluminum Railings: Type 304 stainless-steel fasteners.

B. Post-Installed Anchors: Chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION

A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form work true to line and level with accurate angles and surfaces.

C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

E. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

F. Form changes in direction by bending or by inserting prefabricated elbow fittings.

G. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

H. Close exposed ends of railing members with prefabricated end fittings.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

2.8 ALUMINUM FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Mill Finish: AA-M12, nonspecular as fabricated.

2.9 INSTALLATION, GENERAL

A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

2.10 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members.

2.11 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 055813

COLUMN COVERS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the metal column covers as shown on the drawings and specified herein.

1.3 RELATED WORK

A. Structural Steel - Section 051200.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers

1. The subcontractor shall have a record of successful installations of similar products acceptable to the Architect and shall be currently approved by the manufacturer of the column enclosures.

2. For the actual fabrication and installation of all components of the system, use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups of typical column covers.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Submit completely dimensioned layouts for all areas where metal column enclosures are required, showing:

1. Dimensions, sizes and types of units.

2. Trim and accessories.

3. Details of construction and installation at all conditions.

4. Materials, gauges, thicknesses and finishes.

C. Samples: Prepare and submit samples in the following sizes:

1. Column enclosure, full cross section by 12" high, including a horizontal joint.

2. Each type of trim and accessories, full size.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.

B. Handle products carefully to avoid damaging units in any way.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide column covers by Gordon Tape & Float, Pac-Clad, Fry Reglet, or approved equal.

2.2 COLUMN COVERS

A. General: Provide a complete column cover assembly, including support framing and top and bottom anchorage devices.

1. Support framing to consist of a stainless steel post formed to receive the edges of the column cover components, angles to provide anchorage from post to building structure, and a telescoping mounting bracket at the top of the post. Provide supplementary angles and fasteners for a complete, structurally sound, installation.

2.3 SHEET METAL

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units. Form column covers to shapes indicated from metal of type and minimum thickness indicated below.

B. Aluminum Sheet: Type 5052 alloy complying with ASTM B209, 0.125" thick, with Kynar 500 mica finish complying with AAMA 2605.

2.4 MISCELLANEOUS MATERIALS

A. Sound-Deadening Insulation: Unfaced insulation, minimum thickness ½-inch, as standard with column cover manufacturer and UL-approved.

B. Insulation Adhesive: Duct thermal-insulation adhesive complying with ASTM C 916, Type I or Type III.

C. Flexible Cellular Neoprene Gaskets: ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain airtight seal for application indicated.

D. Fasteners: Use fasteners fabricated from same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting formed-metal fabrications and for attaching them to other work, unless otherwise indicated.

E. Nonstructural Anchors: For applications not indicated to comply with design loads, provide anchors of type, size, and material necessary for type of load and installation indicated, as recommended by the manufacturer. Use nonferrous-metal or hot-dip galvanized anchors for exterior installations and elsewhere as needed for corrosion resistance.

F. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble formed-metal fabrications in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of formed-metal fabrications with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.

C. Form metal to produce flush surfaces without cracking or grain separation at bends.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness specified for stretcher-leveled sheet metal and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install formed-metal fabrications.

2.6 FINISHES, GENERAL

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISH

A. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

2. Custom color and gloss as selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas where metal column covers are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.

B. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

C. Use concealed anchorages where possible.

D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

E. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 CLEANING AND PROTECTION

A. Clean exposed surfaces of metal units and of trim; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

B. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 057113

ORNAMENTAL GLASS RAIL SYSTEM

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the ornamental glass rail system as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Glass guardrails as shown on drawings.

2. Stainless steel cap.

3. Aluminum shoe.

1.3 RELATED SECTIONS

A. Glass and Glazing - Section 088000.

1.4 QUALITY ASSURANCE

A. General: Work of this section shall be fabricated and installed by an experienced fabricator or manufacturer who has been engaged in work of equivalent scope and fabrication standards for at least five (5) years. Materials, methods of fabrication, fitting, assembly, bracing, supporting, fastening, operating devices, and erection shall be in accordance with drawings, specifications, and approved shop drawings, and be of highest quality practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected. All work shall be accurately and neatly fabricated, assembled, and erected.

B. Single-Source Responsibility: Obtain railing systems of each type and material from a single manufacturer.

C. Engineer Qualifications: Professional engineer legally authorized to practice in the State of New Jersey and experienced in providing engineering services of the kind indicated for railing systems similar to this Project in material, design, and extent.

D. Installer Qualifications: A qualified glazing contractorcertified under the NorthAmerican Contractor Certification Program (NACC)for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program OR a glazing contractor that can provide the following:

1). Five (5) years of glazing co. ownership and experience
2). Written references to demonstrate evidence of successfully completed similar projects
3). A formal Safety Program documented in writing
4). A formal Quality Manual documented in writing
5). Resume and qualifications for a Quality Manager
6). Evidence of a fully implemented Quality Management System, including installation quality verification metrics to be utilized on the project.

1.5 SUBMITTALS

A. Shop Drawings: Submit for all items of work, at full scale as far as practical, showing metal and glass thicknesses, arrangement of components, of joining, of jointing, details of all field connections and anchorages, diagrams and details explaining provisions for thermal movement, fastening and sealing methods, glazing methods, and support methods, metal finishes and all other pertinent information.

1. Engineering design and calculations for glass railing assembly - see Article 1.7 herein.

B. Samples - Submit

1. Rail assemblies, 2'-0" long, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

2. Glass, 12" x 12" for each type and thickness indicated.

3. Metal Finishes

a. Submit finish samples, 6" x 6", for finish system specified.
b. The samples submitted shall be representative of the workmanship and finishes of all work of this Section to be incorporated in the completed project.

4. Stainless Steel Caps: Rail assemblies, 2'-0" long, to show end condition, mounting assemblies and typical tight joint and finish.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Glass: At all times during transport, storage and handling of glass, provide cushions at glass edges to prevent damage. Protect glass faces from scratches and abrasion. Protect glass edges from chipping or other damage. Deliver each piece of glass with factory labels (indicating glass type, quality and thickness) and do not remove labels until installation has been approved.

B. Glazing Materials: Deliver glazing materials in manufacturer's unopened containers, fully identified with trade name, color, size, hardness, type, class and grade. Store glazing materials where they will be free from damage in accordance with manufacturer's recommendations.

C. Finished Materials: Protect finishes against soiling, staining or damage from scratches and abrasion. Maintain protection during construction until project completion or as otherwise directed by Architect.

1. Provide wrappings, strippable coatings or other means approved by Architect.

2. During construction, remove protection for visual observation of finish as directed by Architect and replace to maintain protection.

1.7 PERFORMANCE STANDARDS (UNLESS GREATER REQUIRED BY CODE)

A. Loads of Handrails and Guards

1. Handrails and guards shall be designed to resist a load of 50 pounds per lineal foot applied in any direction at the top and to transfer this load through the supports to the structure supporting the rail or guard.

2. Handrail assemblies shall also be able to resist a single concentrated load of 200 pounds applied in any direction at any point along the top. This load can be considered independently of the uniform load noted previously.

3. Intermediate rails, that is, those not the handrail, shall be able to resist a load of 50 pounds on an area not to exceed 1 sf including the openings and spaces between rails. These are not required to be superimposed with the other railing loads noted above.

B. Submit calculations and drawings signed and sealed by a Professional Engineer licensed in the State of Jersey indicating that glass rail system can meet these performance criteria.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials that have been selected for their surface flatness, smoothness, and freedom from surface blemishes where exposed to view in the finished unit. Surfaces exposed to view that exhibit pitting, seam marks, roller marks, oil-canning, stains, discolorations, or other imperfections on the finished units will not be acceptable.

B. Manufacturer: Blumcraft, C. R. Laurence, Inc., Livers Bronze Co. Inc., or approved equal.

C. Aluminum: Comply with the following standards for the forms and types of aluminum for the required items of work:

1. Alloy and Temper: Provide alloy and temper as indicated or as otherwise recommended by the aluminum producer or finisher for type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 221 for 6063-T5; minimum thickness of 0.125".

2. Finish: Aluminum to have mill finish with bituminous coating to separate it from dissimilar metals.

D. Stainless Steel: Comply with the following standards for the forms and types of stainless steel for the required items of work:

1. Type: AISI Type 302/304, unless otherwise indicated.

2. Tubing: ASTM A 554; minimum wall thickness of 0.050"; thicker if required to meet performance standards specified herein.

3. Finish: All stainless steel shall have No. 6 satin directional polish finish.

E. Flat Glass: Flat glass for this Section shall be clear, fully tempered, laminated, and heat soak tested, transparent and glazing quality conforming to ASTM C 1048 and ASTM C1172.

1. Thickness: 3/4".

2. Exposed Edges: Arrised edge (1/16"), ground smooth and polished.

3. Sealed Edges: Arrised edge (1/16") and ground.

F. Glazing and Sealing Materials

1. Neoprene Setting Blocks: Solid 70 to 90 Shore A hardness, size to suit condition.

2. Neoprene Wedges and Spacers: Solid 50 Shore A hardness, size to suit condition.

3. Neoprene Cushions and Gaskets: Closed cell sponge, 20 to 30 Shore A hardness, size to suit condition.

4. Epoxy Adhesive: Pourable, non-shrinking, 70 to 80 Shore A hardness, formulated to suit glazing conditions and stress conditions.

5. Sealant: One-part silicone, sealant, 20 to 30 Shore A hardness, clear or custom color as selected by Architect. "Silicone Sealant 1200" or General Electric. Sealant primers and backing as and if recommended by sealant manufacturer.

G. Protection for Metals: Bituminous paint conforming to FS TT-C-494.

H. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of the metal to be welded, and as required for color match, strength and compatibility in the fabricated items.

I. Fasteners: Furnish of basic metal and alloy, matching finished color and texture as the metal being fastened, unless otherwise indicated. Unless otherwise shown, provide Phillips flat-head screws for exposed fasteners.

2.2 WORKMANSHIP

A. General: Materials, methods of fabrication, fitting assembly, bracing, supporting, fastening, and erection shall be in accordance with drawings and specifications, approved shop drawings, and of the highest quality practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected. All work shall be accurately and neatly fabricated, assembled and erected.

B. Connections: Make connections with tight joints, capable of developing full strength of member, flush. Locate joints as approved by Architect. Provide connections to allow for thermal movement of metal at locations and by methods approved by Architect. For work exposed to view, use concealed fasteners with joints accurately fitted, flush and rigidly secured with hairline contacts.

1. Welding: Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth with and to match finish of adjoining surfaces so that joint will not be visible; undercut metal edges where welds are required to be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surface will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. Remove weld splatter and welding oxides from all welded surfaces.

2. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts. Bolts and screw heads, where shown to be exposed to view, shall be flat and countersunk. Cut off projecting ends of exposed bolts and screws flush with nuts of adjacent metal.

C. Built-In Work: Furnish anchor bolts, inserts, plates and any other anchorage devices, and all other items for architectural metal work to be built into concrete, masonry, or work of other trades, with necessary templates and instructions, and in ample time to facilitate proper placing and installation.

D. Supplementary Parts: Provide as necessary to complete each item of work, even though such supplementary parts are not shown or specified.

E. Coordination: Accurately cut, fit, drill and tap work of this Section to accommodate and fit work of other trades. Furnish or obtain, as applicable, templates and drawings to or from applicable trades for proper coordination of this work.

F. Exposed Work: In addition to requirements specified herein or shown on drawings, all surfaces exposed to view shall be clean, and free from dirt, stains, grease, scratches, distortions, waves, dents, buckles, tool marks, burrs and other defects which mar appearance of finished work. Ornamental metal work exposed to view shall be straight and true to line or curve, smooth arrises and angles as sharp as practicable, miters formed in true alignment, profiles accurately intersecting, and with joints carefully matched to produce continuity of line and design. Exposed fastenings, where permitted, shall be of the same material, color and finish as the metal to which applied, unless otherwise indicated, and shall be of the smallest practicable size.

G. Materials used shall be of such strength, thickness and alloy that they are capable of meeting all standards and descriptions specified herein and as detailed on drawings.

H. Tolerance: Unless otherwise indicated herein, all work of this section shall be plumb, square, level, and correctly aligned within the following limitations:

1. Offset from true horizontal, vertical, and design locations shall not exceed 1/8" per 10' of length for any component, not cumulative.

2. Maximum offset from true alignment between abutting components shall not exceed 1/32".

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where ornamental railing assemblies are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. General: Install work of this Section square, plumb, straight, true to line or radius, accurately fitted and located, with flush, tight hairline joints (except as otherwise indicated or to allow for thermal movement), with provisions for other trades, with provisions to allow for thermal movement, and with attachment devices as required for secure and rigid installation. It is the responsibility of the architectural metal erector to assure himself that shop fabricated architectural metal items will properly fit the field condition. In cases where the shop fabricated architectural metal items do not fit field conditions, the items shall be returned to the shop for correction.

B. Attachments

1. Unless otherwise indicated, work to be built into concrete or masonry shall be anchored with shop welded on galvanized steel strap anchors; work to be attached to concrete or masonry shall be anchored by bolts into embedded non-corrosive metal inserts or expansion shields; work attached to structural steel shall be anchored by welds or bolts; work attached to metals other than structural steel shall be anchored by bolts or screws. Power actuated fasteners not permitted unless approved by Architect.

2. All attachment devices shall be of type, size and spacing to suit condition and as approved by Architect. Provide shims, slotted holes, or other means necessary for leveling, plumbing and other required adjustments. Attachment devices for work exposed to view shall be concealed, unless indicated otherwise.

3. Do all necessary drilling, tapping, cutting or other preparations of surrounding construction in the field accurately, neatly and as necessary for the attachment and support of work of this Section, but obtain Architect's approval prior to such preparation to work of others.

3.3 CLEANING, PROTECTION AND ADJUSTMENT

A. Cleaning and Protection: The Contractor shall protect all work for misuse or damage after installation has been completed. Work which is scratched, etched or damaged will not be accepted by Owner, and shall be replaced with acceptable work. Work shall also be protected against soiling, etching or other contamination. This work shall be done at no additional cost to Owner.

1. The Subcontractor shall be responsible for all breakage of glass whatever the cause until the building is turned over to the Owner. He shall replace all broken glass and deliver the entire building with all glazing intact and clean.

2. Acceptance of building by the Owner shall not take place until all glass has labels removed, is washed and polished, both sides, by a window cleaner specializing in such work.

END OF SECTION

SECTION 060660

RESIN PANELS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resin panels as shown on the drawings and specified herein.

1. Engineered acrylic resin panels.

2. Canopy fabrication.

1.3 RELATED SECTIONS

A. Carpentry - Section 062000.

B. Architectural Woodwork - Section 064023.

C. Gypsum Drywall - Section 092900.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data; include product description, fabrication information, and compliance with specified performance requirements.

B. Submit product test reports from a qualified independent 3rd party testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.

1. Test reports required are:

a. Rate of Burning (ASTM D 635).
b. Self-Ignition Temperature (ASTM D 1929).
c. Density of Smoke (ASTM D 2843).

C. Shop Drawings: Include plans, elevations, sections, panel dimensions, details, and attachments to other work.

D. Samples for Initial Selection: Submit minimum 2-inch by 2-inch samples. Indicate full color, texture, and pattern variation.

E. Samples for Verification: Submit minimum 4-inch by 4-inch sample for each type, texture, pattern, and color of solid plastic fabrication.

F. Mockups

1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects.

2. Build mockup of each type of plastic fabrication.

3. Approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

G. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver plastic fabrications, systems, and specified items in manufacturer's standard protective packaging.

B. Do not deliver plastic fabrications, system, components, and accessories to Project site until areas are ready for installation.

C. Store materials in a flat orientation in a dry place that is not exposed to exterior elements. Materials are to be protected against damage from moisture and direct sunlight.

D. Store acrylic/resin panels in area of installation minimum of 24 hours prior to installation.

E. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.

F. Before installing Plastic Fabrications, permit them to reach room temperature.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install solid polymer fabrications until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

A. Manufacturer’s Special Warranty on Plastic Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.

B. Warranty Period: 1 year after ship date.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Manufacturer: 3form, LLC., Salt Lake City, Utah, USA/ telephone 801-649-2500, or approved equal.

2.2 MATERIALS

A. Basis of Design - Solid Resin Panels: "Varia" as scheduled.

1. Material: Engineered acrylic resin, "Varia Ecoresin."

2. Sheet Size: 48'-0" wide x 120'-0" high.

3. Thickness: 3/16".

4. Color and Finish: As scheduled.

5. Fire-Test-Response Characteristics: Provide original fire test reports to ensure compliance with the following requirements:

a. Rate of Burning (ASTM D 635): CC2 for a nominal thickness of 0.060" and greater.
b. Self-Ignition Temperature (ASTM D 1929): Greater than 850 degrees F.
c. Smoke Density (ASTM D 2843): Less than 10%.

6. Color infusions must use water-soluble dyes and penetrate at least 150 microns into material.

7. Applied coatings must be low-VOC, contain non-toxic pigments, not contain any heavy metals and be approved for exterior use.

8. Matte surface should be completely renewable on site.

2.3 FABRICATION

A. General: Fabricate plastic fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles, and other characteristics are indicated on the drawings.

B. Comply with manufacturer's written recommendations for fabrication.

C. Machining of Varia: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.

1. Sawing: Select equipment and blades suitable for type of cut required.

2. Drilling: Drills specifically designed for use with plastic products.

3. Milling: Climb cut where possible.

4. Routing.

5. Tapping.

D. Machining of Chroma: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.

1. Sawing: Select equipment and blades suitable for type of cut required.

2. Drilling: Drills compatible with plastic products.

3. Routing.

4. Laser Cutting.

5. Laser Etching.

E. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's written instructions.

1. Cold bending.

2. Hot bending.

3. Thermoforming: Acceptable only on uncoated material.

4. Drape forming.

5. Matched mold forming.

6. Mechanical forming.

F. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

G. Bonding of Chroma: Manufacturer must have an in-field seaming process and fabrication kit including necessary adhesive and tools.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaner: Type recommended by manufacturer.

C. Fasteners: Use screws designed specifically for plastics. Provide threaded metal inserts for applications requiring frequent disassembly such as light fixtures.

D. Bonding Cements for Varia: May be achieved with solvents or adhesives, suitable for use with product and application.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine substrates, areas, and conditions where resin panels are to be installed, with Installer present, for compliance with manufacturer’s requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for the installation of solid polymer fabrications. Sizes, profiles, and other characteristics are indicated on the drawings.

B. Shop-fabricate components to the greatest degree possible.

C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed, or discolored as a result of installation or fabrication methods will be rejected.

D. Install components plumb, level, and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

E. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.

3.3 CLEANING AND PROTECTION

A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work that cannot be repaired to the satisfaction of the Architect.

END OF SECTION

SECTION 062000

CARPENTRY

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the carpentry work as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Blocking and miscellaneous wood.
2. Plywood backing panels for telephone and electrical closets.
3. Rough hardware.
4. Framing with dimension lumber.
5. Plywood sheathing.
6. Plywood subflooring and underlayment.
7. Installation only of finish hardware.
8. Installation only of doors and hollow metal frames.

1.3 RELATED SECTIONS

A. Architectural Woodwork - Section 064023.

B. Thermal Insulation - Section 072100.

C. Roofing - Section 075323.

D. Steel Doors and Frames - Section 081113.

E. Flush Wood Doors - Section 081416.

F. Finish Hardware - Section 087100.

G. Gypsum Drywall - Section 092900.

1.4 QUALITY ASSURANCE

A. Lumber Standard: Comply with PS 20.

B. Plywood Standard: Comply with PS 1 and American Plywood Assoc. (APA).

C. Shop fabricate carpentry work to the extent feasible and where shop fabrication will result in better workmanship than feasible for on-site fabrication.

D. Grade Marks: Identify lumber and plywood by official grade mark.

1. Lumber: Grade stamp to contain symbol of grading agency certified by Board of Review, American Lumber Standards Committee, mill number or name, grade of lumber, species grouping or combination designation, rules under which graded where applicable, and condition of seasoning at time of manufacture.

a. S-Dry: Maximum nineteen (19) percent moisture content as per ASTM D 2016.

E. Installation of doors, frames and hardware shall conform to the minimum standards of "Installation Guides for Doors and Hardware" of the Door and Hardware Institute.

1.5 SUBMITTALS

A. Pressure Treatment: Include certification by treating plant stating chemicals and process used, net amount of salts retained and conformance with applicable standards.

B. Fire-Retardant Treatment: Include certification by treating plant that treatment material complies with governing ordinances and that treatment will not bleed through finished surfaces.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver carpentry materials to the site ready to use with each piece of lumber clearly marked as to grade, type and mill, and place in an area protected from the elements.

B. Deliver rough hardware in sealed kegs and/or other containers which shall bear labels as to type and kind.

C. Pile lumber for rough usage, when delivered to the site in stacks to insure drainage and with a minimum clearance of six (6) inches above grade. Cover stacks with tarpaulins or other watertight coverings. Store grounds and similar small sized lumber inside the building as soon as possible after delivery.

D. Do not store seasoned lumber in wet or damp portions of the building.

E. Protect fire retardant treated materials against high humidity and moisture during storage and erection.

F. Remove delivered materials which do not conform to specified grading rules or are otherwise not suitable for installation from the job site and replace with acceptable materials.

G. All items specified in Section 087100 of this specification entitled "Finish Hardware" shall be received, accounted for, stored and applied under this Section.

H. Hardware shall be sorted and stored in space assigned by Contractor and shall be kept at all times under lock and key. The safety and preservation of all items delivered will be the responsibility of the Contractor.

1.7 JOB CONDITIONS

A. Installer must examine the substrates and supporting structure and the conditions under which the carpentry work is to be installed, and notify the Contractor in writing of conditions detrimental to the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer and the Architect.

B. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

PART 2 PRODUCTS

2.1 WOOD MATERIAL

A. General

1. All wood shall be sound, flat, straight, well-seasoned, thoroughly dry and free from all defects. Warped or twisted wood shall not be used.

2. For miscellaneous wood blocking, grounds, furring as required, use Utility Grade Coastal Douglas Fir or Southern Pine, free from knots, shakes, rot or other defects, straight, square edges and straight grain, air seasoned with maximum moisture content of nineteen (19) percent. Wood shall be S4S, S-Dry, complying with PS-20.

B. Lumber, General

1. Factory-mark each piece of lumber with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.

2. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

3. Provide seasoned lumber with 19% max. moisture content at time of dressing.

C. Framing Lumber and Miscellaneous Lumber (2" through 4" thick and less than 6" wide): For light framing and miscellaneous lumber (furring, grounds, blocking), provide No. 2 grade lumber for stud framing and "Standard" grade for other light framing, any species.

D. Plywood

1. For roof sheathing, provide APA Structural 1 Rated Sheathing, Exposure 1, with span rating to suit joist or truss spacing; thickness as noted on drawings.

2. For wall sheathing, provide APA Structural 1 Rated Sheathing, Exposure 1, with span rating to suit stud spacing; thickness as noted on drawings.

3. For subflooring, provide tongue and groove APA Sturd-I-Floor, Exposure 1, with span rating to suit joist spacing; thickness as noted on drawings.

4. For underlayment over subflooring, provide APA Underlayment INT with exterior glue, thickness as noted on drawings.

5. Plywood and rough carpentry for telephone and electrical closets, provide 3/4" thick C-D EXT-APA plywood, fire retardant treated as specified herein.

E. Wood Treatment: Pressure treat wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete, using water-borne preservatives complying with AWPA U1. After treatment, kiln dry to a max. moisture content of 19%.

1. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment.

2. All interior wood material specified herein shall be fire retardant treated to comply with the AWPA standard U1 to achieve a flame spread rating of not more than 25 (UL Class "FR-S") when tested in accordance with UL Test 723 or ASTM E 84. The fire retardant chemicals used to treat the lumber must comply with FR-1 of AWPA Standard P49 and be free of halogens, sulfates and ammonium phosphate.

a. After treatment, kiln dry to a moisture content of fifteen (15) percent; if wood is to be painted or finished, kiln dry to a moisture content of twelve (12) percent. Treatment shall be equal to "Dricon" made by Arch Wood Protection Inc. or approved equal. Provide UL approved identification on treated materials.

3. For exterior blocking, roofing and sheet metal, pressure treat wood with copper azole, Type B (CA-B); ammoniacal copper quat (ACQ) or similar preservative product that contains no arsenic or chromium. Preservative shall comply with AWPA Standard U1, (.25 lbs./cubic foot of chemical in wood).

a. After treatment, kiln dry to a maximum moisture content of fifteen (15) percent. Treatment shall be equal to "Wolmanized Natural Select" made by Arch Wood Protection Inc. or approved equal.

4. Treated wood that is cut or otherwise damaged shall be further treated in accordance with the AWPA Standard M-4.

2.2 HARDWARE

A. Rough Hardware for Treated Woods and Exterior Use: Hot-dipped galvanized or Type 304 stainless steel.

B. Nails: Common steel wire, untreated for interior work as per ASTM F 1667.

C. Bolts: Standard mild steel, square head machine bolts with square nuts and malleable iron or steel plate washers or carriage bolts with square nuts and cut washers conforming to the following:

1. Bolts: ASTM A 307, Grade A.

2. Nuts: ASTM A 563.

3. Lag Screws and Bolts: ASME B 18.2.1.

D. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material for Treated Woods and Exterior Use: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2. Material for Other Uses: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

E. Wood Screws: ASME B 18.6.1.

F. Concrete and Masonry Anchors: Standard expansion-shield self-drilling type concrete anchors where so shown or noted on the drawings, or where approved by the Architect.

2.3 MISCELLANEOUS MATERIALS

A. Air Barrier: See Section 072700.

B. Provide metal hangers and framing anchors equal to Simpson Ty-Down, Rafter Anchors, and Joist & Beam Hangers, or approved equal.

C. Fasteners: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices.

D. Where rough carpentry work is exposed to weather or in ground contact, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

E. Termite Shield: 26 ga. galvanized steel sheet.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where carpentry is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION, GENERAL

A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

B. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.

C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.

1. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

3.3 INSTALLATION OF FINISH HARDWARE

A. Hardware shall be carefully fitted and securely attached, in accordance with these specifications and the instructions of the various manufacturers.

B. Unless otherwise noted, mount hardware units at heights established in Section 081113.

C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in a secure place during the finish application. After completion of the finishes, re-install each item. Do not install surface-mounted items until finishes have been completed on the substrate.

D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

F. Cut and fit threshold and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.

G. All keys used shall be construction keys which are to be tagged with fiber discs as approved, clearly labeled with identifying inscriptions and then neatly arranged in a temporary cabinet. All construction keys shall be returned to the Owner.

H. Adjusting and Cleaning

1. Adjust and check each operating item of hardware and each door, to ensure proper operation and function of every unit. Lubricate moving parts with type lubrication recommended by manufacturer (graphite type if no other recommended). Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.

2. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make a final check and adjustment of all hardware items in such space or area. Clean and re-lubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

3.4 INSTALLATION OF DOORS AND FRAMES

A. Preparation

1. Remove welded-in shipping spreaders installed at factory.

2. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

3. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

B. Installation

1. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

2. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. Install frames in accordance with ANSI/SDI A250.11, Recommended Erection Instructions for Steel Frames, unless more stringent requirements are specified herein.
    b. At fire-protection-rated openings, install frames according to NFPA 80.
    c. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    d. Install frames with removable glazing stops located on secure side of opening.
    e. Frames set in masonry walls shall have door silencers installed in frames before grouting.
    f. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    g. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with post-installed expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

4. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames conforming to the requirements of Section 072100 "Thermal Insulation."

5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar; refer to Section 042000 "Unit Masonry" for installation of frames in masonry walls.

6. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. In-Place Gypsum Board Partitions: Secure frames in place with post-installed expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.

9. Installation Tolerances: Adjust steel door frames for squareness, alignment, twist, and plumb to the tolerance given in HMMA 841 of ANSI/NAAMM, current edition.

10. Steel Doors: Fit hollow metal doors accurately in frames to the tolerances given in HMMA 841 of ANSI/NAAMM, current edition.

    a. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

11. Glazing: Comply with installation requirements in Section 088000 "Glass and Glazing" and with standard steel door and frame manufacturer's written instructions.

    a. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c., and not more than 2 inches o.c. from each corner.

C. Wood Doors

1. Condition doors to average prevailing humidity in installation area prior to hanging.

2. Install doors in accordance with manufacturer’s instructions.

3. Fit door to frames and machine for hardware to whatever extent not previously worked at factory as required for proper fit and uniform clearance at each edge.

4. Clearances: Install doors to meet clearance requirements specified in Section 081416.

5. Fire-Rated Doors: Install in corresponding fire-rated frames in accordance with the requirements of NFPA No. 80. Provide clearances complying with the limitations of the authority having jurisdiction.

D. Adjustments: Check and readjust operating finish hardware items just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise unacceptable.

3.5 BLOCKING AND MISCELLANEOUS WOOD

A. General

1. Erect rough carpentry true to line, levels and dimensions required; squared, aligned, plumbed, and securely fastened in place.

2. Shim where required to true up furring, blocking and the like. Use wood or metal shims only.

3. Do all cutting, fitting, drilling and tapping of other work as required to secure work in place and to perform the work included herein. Do all the cutting and fitting of carpentry work, for the work of other trades as required.

B. Blocking and Miscellaneous Wood

1. Furnish and install all wood grounds, furring, blocking, curbs, bucks, nailers, etc., that may be necessary and required in connection with the carpentry and with the work described for any other trades and including required carpentry for electrical fixtures. All blocking and nailers shall be continuous wherever required, whether or not so indicated.

2. Blocking shall be as required for the proper installation of the finished work and for items in mechanical sections as required. Blocking, edgings, stops, nailing strips, etc., shall be continuous, unless distinctly noted otherwise. Provide blocking as required to install all equipment. Provide blocking and nailers where shown or required to fasten interior sheet metal work.

3. Fastening for wood grounds, furring and blocking shall be of metal and of type and spacing as best suited to conditions. Hardened steel nails, expansion screws, toggle bolts, self-clinching nails, metal plugs, inserts or similar fastenings shall be used, of suitable type and size to draw the members into place and securely hold same.

C. Rough Lumber for Roofing and Sheet Metal

1. Furnish and install all wood nailing strips and wood blocking required in connection with respective types of roofing, fans, flashings, and sheet metal work, using preservative treated wood as herein before specified.

2. Wood blocking shall be of sizes and shapes as indicated on the drawings and/or designed for the reception of curb flashings for roof ventilators and similar items.

3. All nailing strips and blocking shall be carried out in accordance with the printed installation instructions, and/or recommendations of the accepted manufacturer of

the roofing materials, and in coordination and cooperation with the sheet metal work trades.

4. All blocking and nailing strips shall be firmly secured in place using counter bored bolt and nut fastenings, or secured by any other proposed flush surfaced fastenings.

5. Wood nailing strips or blocking required to be embedded in concrete work shall be furnished in time due for placing, prior to start of concrete operations. Locations and spacings of nailing strips or blocking shall be performed in coordination with the concrete trades, as required for respective installations.

3.6 WOOD FRAMING, GENERAL

A. Provide framing members of sizes and on spacings shown, and frame openings as shown, or if not shown, comply with "Details for Conventional Wood Frame Construction" of AFPA. Do not splice structural members between supports.

1. Anchor and nail to comply with the following minimum standards:

a. Blocking to joist bearing: Two 10d toenailed each side
b. Blocking to joist or stud: Two 10d toenailed each side
c. One inch brace to stud: Two 8d face nailed
d. Two inch brace to stud: Two 16d face nailed
e. Bridging to joint: Two 8d toenailed
f. Built-up beams 8" or less in depth: 16d at 12" o.c., staggered
g. Joists and rafters to support: Two 10d toenailed each side
h. At laps 12" min.: Four 16d face nailed
i. Multiple joists: 16d at 12" o.c., staggered
j. Joists to sill or girder: Two 16d toenailed
k. 1" furring to underside of joints: Two 8d (one straight; one slanted)
l. 2" furring to underside of joints: Two 16d (one straight; one slanted)
m. Studs toenailed to plate: Two 10d each side
n. Studs end nailed to plate: Two 16d at 12" o.c., staggered
o. Plates: Upper to lower: 16d at 12" o.c., staggered
p. At splices: Two 16d face nailed
q. Plate lap at corners: Two 16d face nailed

B. Firestop concealed spaces with wood blocking not less than 2" thick, if not blocked by other framing members. Provide blocking at each building story level and at ends of joist spans.

C. Stud Framing

1. General: Provide stud framing where shown. Unless otherwise shown, use 2" x 4" wood studs spaced 16" o.c. with 4" face perpendicular to direction of wall or partition. Provide single bottom plate and double-top plates 2" thick by width of studs; except single top plate may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction.

2. Construct corners and intersections with not less than 3 studs. Provide miscellaneous blocking and framing as shown and as required for support of facing materials, fixtures, specialty items and trim.

3. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.

    a. For non-bearing partitions, provide double-jamb studs and headers not less than 4" deep for openings 3' and less in width, and not less than 6" deep for wider openings.
    b. For load-bearing partitions, provide double-jamb studs for openings 6'-0" and less in width, and triple-jamb studs for wider openings. Provide headers of depth shown, or if not shown, provide as recommended by N.F.P.A. "Manual for House Framing."

D. Joist Framing

1. General: Provide framing of sizes and spacings shown. Install with crown edge up and support ends of each member with not less than 1-1/2" of bearing on wood or metal, or 3" on masonry. Attach to wood bearing members by toe nailing or metal connectors; frame to wood supporting members with wood ledgers as shown, or if not shown, with metal connectors. Fire-cut members built into masonry (if any). Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 4'-0". Do not notch in middle third of joists; limit notches to 1/6-depth of joist, 1/3 at ends. Do not bore holes larger than 1/3-depth of joist or locate closer than 2" from top or bottom. Provide solid blocking (2" thick by depth of joist) at ends of joists unless nailed to header or band member.

2. Lap members framing from opposite sides of beams, girders or partitions not less than 4" or securely tie opposing members together. Provide solid blocking (2" thick by depth of joist) over supports.

3. Anchor members paralleling masonry with 1/4" x 1-1/4" metal strap anchors spaced not more than 8'-0" o.c. Extend anchors at least 4" into masonry, turn up 4" and extend over and fasten to 3 joists.

4. Under jamb studs at openings, provide solid blocking between joist.

5. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above. Provide triple-joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures, unless otherwise shown.

6. Provide bridging between joists where nominal depth-to-thickness ratio exceeds 4, at intervals of 8'-0". Use bevel cut 1" x 4" or 2" x 3" wood bracing, double-crossed and nailed both ends to joists, or use solid wood bridging 2" thick by depth of joist, end nailed to joist.

E. Rafter and Ceiling Joist Framing

1. Ceiling Joists: Provide member size and spacing shown, and as previously specified for joist framing. Face nail to ends of parallel framing members.

2. Rafters: Provide member size and spacing shown. Notch to fit exterior wall plates and toe nail or use special metal framing anchors. Double rafters to form heads

and trimmers at openings in roof framing (if any), and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

a. At valleys, provide valley rafter of size shown, or if not shown, provide rafter twice as thick as regular rafters and 2" deeper. Bevel ends of jack rafters for full bearing against hip rafters.

3. Provide collar beams (ties) as shown, or if not shown, provide 1" x 6" boards between every third pair of framing members. Locate below ridge member, one-third of distance to ceiling joists. Cut ends to fit slope and nail to framing.

4. Provide special framing as shown for eaves, overhangs, dormers and similar conditions, if any.

3.7 WOOD SHEATHING

A. Plywood Roof Sheathing

1. Install plywood roof sheathing with long dimension across supports, using panels continuous over 2 or more spans with end joints between panels staggered and located over center of supports.

a. Nail 6" o.c. along panel edges and ends and 12" o.c. at intermediate supports for spans less than 48" using 6d common nails for panels 1/2" or less, 8d common nails for panels over 1/2" but less than 1" thick, and 8d ring shank or spiral thread nails or 10d common nails for panels 1" or more thick. For spans 48" or greater, space nails 6" o.c. at all supports.
b. Provide support at unsupported long edges with "Plyclips" or wood blocking.

2. Allow 1/8" open space between end joints and 1/4" open space between edge joints for expansion and contraction of panels.

B. Plywood Wall Sheathing: Install plywood wall sheathing horizontally or vertically using panels continuous over 2 or more spans. Nail edges and ends over supports at 6" o.c. and at 12" o.c. over intermediate studs using 6d nails for panels not more than 1/2" thick and 8d nails for thicker panels. Allow 1/8" spacing at panel ends and 1/4" at panel edges.

C. Plywood Flooring

1. Subflooring: Install T & G plywood with the long dimension of the panel across supports and with panel continuous over two or more spans. Panel end joints shall occur over framing. Allow 1/8" spacing at panel ends and edges. Nail 6" o.c. along panel edges and 10" o.c. at intermediate supports with 6d common nails for 1/2" panels, 8d for greater thicknesses. Where panels are 1-1/8" or 1-1/4" thick and supports are 48" o.c., nails shall be 8d ring-shank or 10d common and spaced 6" o.c. at all supports.

2. Underlayment: Panels to receive resilient floor coverings shall have edge joints filled and thoroughly sanded. Apply underlayment just prior to laying finish floor and protect against damage until finish floor is installed. Stagger panel end joints with respect to each other and offset all joints with respect to the joints in the

subfloor. Butt panel ends and edges to a close but not tight fit (allow 1/32" space). Nail 6" o.c. along panel edges and 8" o.c. each way throughout remainder of panel with 3d ring-shank nails for thicknesses 1/3" or less, 4d for 5/8" and 3/4", or use 15 ga. staples at 3" o.c. along panel edges and 6" o.c. each way. Staple length must be sufficient to penetrate at least 5/8" into or completely through, subflooring. Lightly sand any surface roughness, particularly at joints and around nails.

D. Telephone and Electrical Equipment Mounting Boards

1. Furnish and install 3/4" thick plywood panels to the walls of the telephone and electrical equipment rooms in accordance with the requirements of the local utility company.

2. Secure to wall using proper devices for substrates encountered, spaced twelve (12) inches o.c., maximum around the edges, 1-1/2" from corners, and in three (3) rows of three (3) each in the field. Recess fastening devices flush with the plywood surface. Adjacent panels shall be butted with 1/16" space between without lapping.

3.8 ROUGH HARDWARE

A. Securely fasten rough carpentry together. Nail, spike, lag screw or bolt as required by conditions encountered in the field and the Contract Documents.

B. Provide rough or framing hardware, such as nails, screws, bolts, anchors, hangers, clips, inserts, miscellaneous fastenings, and similar items of the best quality and of the proper size and kind to adequately secure the work together and in place, in a rigid and substantial manner.

C. Secure rough carpentry to masonry with countersunk bolts in expansion sleeves or other acceptable manner, with fastenings not more than sixteen (16) inches apart. Secure woodwork to hollow masonry with toggle bolts spaced not more than sixteen (16) inches apart.

D. Countersink bolts in nailers and other rough woodwork and include washers and nuts. Cut bolts off flush with surfaces and peen as may be required to receive finished work.

E. Inserts to secure wood nailers to concrete shall be malleable iron threaded inserts with 3/8" diameter bolts of length to allow for countersinking. Locate at end of each nailer and at intervals not exceeding thirty (30) inches o.c.

F. Furnish to the mason for building into the work, or attaching the work which is to be built in, anchors, bolts, wall plates bolted to masonry, corrugated wall plugs, nailing blocks, etc., which are required for the proper fastening and installation for the work or other items as called for in this Section.

G. Detailed instructions with sketches of necessary requirements, shall be given to the masonry trade showing the location and other details of such nailing devices.

3.9 CLEANING UP

A. General: Keep the premises in a neat, safe and orderly condition at all times during execution of this portion of the work, free from accumulation of sawdust, cut-ends and debris.

B. Sweeping

1. At the end of each working day, or more often if necessary, thoroughly sweep all surfaces where refuse from this portion of the work has settled.

2. Remove the refuse to the area of the job site set aside for its storage.

3. Upon completion of this portion of the work, thoroughly broom clean all surfaces.

END OF SECTION

SECTION 064023

ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the architectural woodwork as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Wood trim.
2. Wood millwork and counters with plastic laminate finish.
3. Hardware for architectural woodwork.
4. Wood shelving.
5. Solid surfacing material countertops and window sills.
6. Wood framing and rough lumber as required for work of this Section.
7. Wood grounds, blocking, nailers, furring as required for work of this Section.
8. All rough hardware and fastenings for work of this Section.
9. Drilling concrete and masonry, drilling and/or tapping metal work, as required, for the installation of work of this Section.
10. Back painting as specified herein.
11. Shop finish of work of this Section, except items indicated herein to be shop primed only.

1.3 RELATED SECTIONS

A. Carpentry - Section 062000.

B. Joint Sealers - Section 079200, for caulking between architectural woodwork and any wall, floor, or ceiling joints

C. Flush Wood Doors - Section 081416.

D. Painting and Finishing - Section 099000, for field finishing of architectural woodwork.

1.4 QUALITY STANDARDS

A. The quality standards of the Architectural Woodwork Institute, "Architectural Woodwork Standards," 2nd Edition, dated October 1, 2014, and enhancements 2019, shall apply to all workmanship including materials and installation, for architectural woodwork and by reference are made a part of this specification. All work shall conform to "Premium" grade requirements of the AWI "Architectural Woodwork Standards," unless otherwise modified herein.

B. In the event of a dispute as to the quality grade (or grades), the Contractor shall call upon the Architectural Woodwork Institute for an inspection under AWI's Quality Certification Program which shall include a QCP Inspection and Report. The Contractor agrees to abide by the decision of this Report. The cost of said inspection and report shall be borne by the Contractor.

C. Employ only tradesmen experienced in the fabrication and installation of architectural woodwork.

D. Woodworking firm must be accredited by the AWI Quality Certification Program (QCP).

E. Provide fire test reports by an accredited testing laboratory of all woodwork demonstrating compliance with fire rating classification as required by Code.

1.5 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings of all woodwork specified and indicated on the drawings. Shop drawings shall indicate room plans and elevations at 3/4" equals 1'-0" scale and typical construction details at 3" equals 1'-0" scale. Shop drawings shall indicate all materials, thicknesses, and finishes.

2. Shop drawings shall show all finish hardware, anchors, fastenings, and accessories.

3. Shop drawings shall show all jointing, joint treatment and butt jointing in plastic laminate.

4. Shop drawings for cabinet work must show centerline height and horizontal location of all required internal wall blocking.

5. Where architectural woodwork deviates from AWI standards noted herein, shop drawings must identify these deviations.

B. Samples: Submit samples of each of the following items:

1. Plastic laminate, twelve (12) inches square, including a section of outside corner.

2. Transparent finish for each species of wood veneer laminated to particleboard, twelve (12) inches square, for each finish specified or shown.

3. Opaque finish wood veneer laminated to particleboard, twelve (12) inches square for each color, gloss and finish specified or shown.

4. Each type and finish of each type of wood trim, eight (8) inches long, finish as specified.

5. Cabinet hardware.

1.6 QUALIFICATIONS

A. The work of this Section shall be provided by a firm having a minimum of five (5) years' experience on projects of similar size and quality to that specified and shown.

1.7 COORDINATION

A. Coordinate the work of this Section with other appropriate Sections of the specifications to insure proper scheduling for fabrication and installation of the work specified herein.

B. Coordinate with partition and finish trades to insure that proper provisions are made for the installation of the work specified herein.

C. Verify all dimensions in the field prior to fabrication of all Architectural Woodwork to assure proper fit.

1.8 PRODUCT HANDLING

A. All materials and work of this Section shall be protected from damage from time of shipment from shop to final acceptance of work. Cover, ventilate, and protect work of this Section from damage caused by weather, moisture, heat, staining, dirt, abrasions, any other causes which may adversely affect appearance or use, or which may cause deterioration of finish, warping, distortion, twisting, opening of joints and seams, delamination, loosening, etc., of work of this Section.

B. Keep all finish carpentry, millwork, and cabinet work under cover both in transit and at the premises. Do not deliver any finish carpentry, millwork, or cabinet work before it is required for installation. Protect such work to avoid damage in transit, during erection and after erection until acceptance of the building; use all such methods to provide the proper protection. Remove such protection when directed by the Architect.

C. Deliver finish carpentry, millwork, and cabinet work in a dry stable condition; protect same against injury and dampness. Do not store or install finish carpentry, millwork, or cabinet work until after the concrete, masonry and plaster work are thoroughly dry.

D. Damaged or defective items of work of this Section are subject to rejection and replacement with new by Contractor, at no cost to Owner.

1.9 JOB CONDITIONS

A. Humidity Controls: The ambient relative humidity at the site, including both the storage and the installation areas, shall be maintained between 25% and 55% prior to delivery and through the life of the installation.

B. Determine equilibrium moisture content and maintain required temperature and relative humidity as required for a tolerance of plus or minus one (1) percent of the specified optimum moisture content until woodwork receives specified finishes. Refer to "Guide to Wood Species Selection," AWI, for method of determining equilibrium moisture content values.

C. Examination of Substrate and Conditions: The installer must examine the substrate and the conditions under which the work of this Section is to be performed and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with work under this Section until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

D. Areas to receive architectural woodwork must be fully enclosed with windows and/or curtain wall installed and glazed, exterior doors in place, HVAC systems operational, and temporary openings closed. Any plaster, wet grinding and concrete work shall be fully dry.

E. Architectural woodwork shall be allowed to come to equilibrium on site for 7 days prior to installation.

PART 2 PRODUCTS

2.1 BASIC REQUIREMENTS

A. Wood Moisture Content: Provide kiln-dried (KD) lumber with an average moisture content range of nine (9) to twelve (12) percent for exterior work and six (6) to eleven (11) percent for interior work.

B. Measurements: Before proceeding with woodwork required to be fitted to other construction, obtain field measurements and verify all dimensions of shop drawing details as required for accurate fit.

C. Compatibility of Grain and Color: Architect reserves the right to select materials for best compatibility between visually related members and veneers.

D. Machine and sand woodwork to comply with requirements of Standards for specified grade.

E. Fabricate woodwork to dimensions, profiles and details shown. Rout or groove back of flat trim members, kerf backs of other wide flat members except plywood or veneered members.

F. Miter joints by joining, splining, and gluing to comply with requirements for the specified grade.

G. Inspect each piece of lumber and plywood or each unit of woodwork after drying; do not use twisted, warped, bowed, or otherwise damaged or defective wood.

2.2 GENERAL - MATERIALS

A. Softwood lumber shall conform to the requirements of the latest edition of American Lumber Standards Simplified Practice Recommendation R-16. Grades shall conform to the grading rules of the Association having jurisdiction and shall bear the official grade and trademark of the Inspection Bureau of the Association and a mark of mill identification.

B. Framing and Rough Lumber: No. 1 KD grade Southern Pine or Dense Construction grade Douglas Fir, having extreme fiber in bending stress of at least 1700 psi, surfaced

four sides (S4S). Provide fire retardant treatment meeting requirements of Section 062000.

C. Grounds, Blocking, Nailers, Furring: Southern Pine, Douglas Fir or Sitka Spruce, grade to suit particular purpose and to be straight, square edged, straight grained, surfaced four sides (S4S), and which will retain nails and screws without splitting. Provide fire retardant treatment.

D. Wood Veneers and Lumber: Provide AWI Premium Grade materials and workmanship. For species not listed in the AWS comply with the following:

1. Provide AWS Lumber Grade Premium and AWS Grade AA Veneer, book-matched, minimum 6-inch face veneer width. Kiln dry to 6-8 percent moisture content. Components shall be free of defects and sapwood. Match adjacent pieces for color and grain pattern.

2. Single-Source Requirement for Wood Veneers and Solids: Intent is to provide wood which matches as closely as possible throughout the project. Provide wood veneers and solids from the same distributor, and from the same flitches and solids sources to the greatest extent possible.

E. Lumber: AWI Section 100 with the following requirements:

1. Hardwood for Transparent Finish: Premium Grade, select species and cut to match adjoining veneers, unless otherwise shown or specified, and free from cat’s eyes, bird’s eyes, burls, curls, or cross grains.

2. Hardwood for Opaque Finish: Any hardwood which, when finished, will not show any grain, imperfection or other surface defects when used with the opaque finish specified.

F. Plywood: AWI Section 4; Veneer core, particle or plywood core unless otherwise specified, and with the following requirements:

1. Hardwood: Premium Grade, face veneers as shown or specified

2. Particleboard: Premium Grade, fire retardant for wall paneling only equal to Duraflake FR and Duraflake for cabinets. Particleboard shall be certified to meet EPP CPA 3-08 formaldehyde emission limit of 0.18 ppm and contain no added formaldehyde resins.

3. Medium-Density Fiberboard (MDF): Conforming to ANSI A208.2, Grade 130 and ANSI MR10 moisture-resistant properties on 5/8" or thicker board. MDF shall be certified to meet EPP CPA 3-08 formaldehyde emission limit of 0.21 ppm and contain no added formaldehyde resins.

4. Edges: Banded with hardwood in accordance with Premium Grade Standards.

G. Wood Species and Cut for Transparent Finish: Quarter sliced/sawn, species as selected by the Architect.

1. Architect's control samples for transparent finish, veneer grain and figure characteristics are available for review at the office of the Architect.

H. Veneer Matching Requirements:

1. Matching Between Adjacent Veneer Leaves: Book match and architectural end match.

2. Matching Within Individual Panel Faces: Balance and Center Match.

3. Method of Matching Panels: Blueprint-matched panels and components.

I. Finishing (Wood)

1. Transparent Finish

a. AWI Factory Finish System "Conversion Varnish, System 5, Transparent."
b. AWI Premium Grade.
c. Stain: As selected by the Architect.
d. Degree of Sheen: Dull satin.

2. Opaque Finish

a. AWI Factory Finish System "Conversion Varnish, System 5, Opaque."
b. AWI Premium Grade.
c. Degree of Sheen: Satin.
d. No grain to show.

2.3 PLASTIC LAMINATE

A. Face Sheets: NEMA Publication LD3, Grade GP50, Type I, 0.05" thick, as manufactured by Abet Laminati, Formica, WilsonArt, or approved equal. Color, pattern and finish as selected by the Architect.

B. Backing Sheets: Non-decorative, high-pressure plastic laminate, NEMA LD3, Grade BK20, 0.02" thick.

C. Edges: Finish with plastic laminate to match face and applied before face sheets are applied, unless otherwise shown or specified.

2.4 METAL

A. Steel

1. Structural Steel Shapes and Plates: ASTM A 36.

2. Hot-Rolled Carbon Steel Sheets: Commercial quality, ASTM A 569, may be used for concealed parts only. Galvanize sheets for planters.

B. Primer for Unexposed Metal: Zinc chromate primer.

2.5 MISCELLANEOUS PRODUCTS

A. Fasteners

1. Wood Screws: FS FF-S-111, type, size, material, and finish as required for the condition of use.

2. Nails: FS FF-N-105, type, size, material, and finish as required for the condition of use.

3. Anchors: Type, size, material, and finish as required for the condition of use.

4. Staples: Upholstery type staples of sufficient strength to hold fabric taut in place without sagging.

B. Adhesives

1. For Laminating Plastic Laminate Surfaces: Urea resin, Type II, as recommended by fabricator.

2. For All Other Uses: Polyvinyl acetate resin emulsion or other type as recommended by the fabricator.

2.6 CABINETS WITH PLASTIC LAMINATE FINISH

A. General

1. Fabricate all cabinetry and millwork to the "Premium Grade" standards of the AWS, Section 10.

2. Face construction of cabinets shall be "Flush Overlay."

3. Provide 3/4" thick doors, drawer fronts and fixed panels (including thickness of plastic) except where required to be thicker by Standards; and provide flush units.

4. Provide dust panels of 1/4" thick plywood or tempered hardboard above compartments and drawers, except where located directly below countertops.

5. Exposed Edges: Plastic laminate matching exposed panel surfaces. Ease exposed edge of overlap sheet.

B. Plastic Laminate

1. Plastic Laminate for Horizontal Surfaces: 0.050" thick, general-purpose type (high pressure).

2. Plastic Laminate for External Vertical Surfaces: 0.028" thick, general-purpose type (high pressure).

3. Plastic Laminate for Post Forming: 0.042" thick, post forming (high pressure).

4. Plastic Laminate for Cabinet Linings: 0.020" thick, cabinet liner (high pressure).

5. Plastic Laminate for Concealed Panel Backing: 0.020" thick, backer type (high pressure).

6. Plastic Laminate Colors and Patterns: As selected by the Architect from manufacturer’s standard satin finish products.

C. Shop Assembly: All work shall be shop assembled. Work that is too large for entrance into the use area shall be fabricated in attachable sections with provisions for reconnection in the using space.

D. Material Thicknesses: See drawings for general material thicknesses. Minimum thickness of solid lumber for web frames, trim, bases, etc., shall be 3/4". Minimum thickness of plywood and particleboard shall be 3/4".

E. Sizes: See drawings for woodwork sizes required. The manufacturer shall check field dimensions and verify all openings and actual field conditions prior to fabrication of work.

F. Manufacturer is responsible for rigidity and structural stability.

2.7 PLASTIC LAMINATE COUNTERTOPS

A. Grade: Same as AWI grade required for cabinet work; plastic laminate finish.

B. Construction

1. Provide back-splash and end-splash, where detailed; top-mounted square butt joint, fully covered with matching plastic laminate, eased edges.

2. Exposed Counter Edges: Plastic laminate matching surface, except as otherwise indicated. Ease exposed edges of overlap sheet.

3. Cut openings for equipment to be installed. Comply with equipment manufacturer's requirements; provide internal corners of 1/8" minimum radius. Smooth saw cut and ease edges.

4. Seal cut edges of counter at openings for sinks and other "wet" equipment, using waterproofing compound recommended by plastic manufacturer and compatible with laminating adhesive.

2.8 HARDWARE

A. Architectural Woodwork Hardware: Provide the following items, or their approved equal, as required:

1. Hinges: Hafele concealed hinges.

2. Catches: Magnetic; top and bottom.

3. Pulls: Selected by the Architect.

4. Locks: Directed by the Architect.

5. Drawer Slides

a. 24" Maximum Width: Accuride, Model 7434, full extension, 100 lb. capacity.
b. 16" Maximum Width, Easy Close: Accuride Model 3832C, full extension, 100 lb. capacity.

6. Shelf Supports: Pin and grommet system equal to No. 282.01.701 pin and 282.50.704 grommet made by Hafele.

7. Finish: Satin stainless steel.

B. Closet Hardware: Oval wardrobe rails, chrome-plated steel with center bracket and wall-support brackets made by Hafele, or approved equal.

2.9 WOOD TRIM

A. Quality Standard: For the following types of interior architectural woodwork, comply with indicated standards as applicable.

1. Standing and Running Trim: AWS Section 6.

2. Miscellaneous Millwork: AWS Section 6.

B. Woodwork for Transparent Finish: Except as otherwise indicated, comply with the following:

1. Grade: Premium.

2. Species of Solid Wood: Quarter Sawn species as noted on drawings.

C. Woodwork for Paint Finish: Except as otherwise indicated, comply with the following:

1. Grade: Premium.

2. Species of Solid Wood: Solid, paint grade, sound clear Poplar or Birch.

2.10 SOLID SURFACING MATERIAL COUNTERTOPS

A. Provide 1/2" thick "Corian" countertops, with integral bowls where indicated, as manufactured by E.I. DuPont or comparable product by Avonite, WilsonArt, Gibraltar, or approved equal meeting standards specified herein. Countertops shall be of color as selected by the Architect.

B. Material: Cast, filled, acrylic; not coated, laminated or of composite construction, meeting ANSI Z124-1980, Type Six, and ISS FA-2.01 "Classification and Standards Publication of Solid Surfacing Material" as published by the International Solid Surface Fabricators Association (ISSFA).

C. Countertops shall be adhesively joined with no exposed seams, having edge details shown on drawings.

D. Material shall conform to the published performance characteristics of ISSFA-2-01.

E. Joint Adhesive: Manufacturer's standard two-part adhesive kit to create inconspicuous, non-porous joints.

F. Sealant: Manufacturer's standard mildew-resistant, FDA/UL recognized silicone sealant in colors matching components.

G. Fabrication

1. Fabricator must be approved by the solid surface manufacturer.

2. Factory fabricate components to custom sizes and shapes indicated, in accordance with approved shop drawings.

3. Form joints between components using manufacturer's standard joint adhesive; without conspicuous joints.

4. Provide factory cutouts for plumbing fittings and accessories as indicated on the drawings.

5. Cut and finish component edges with clean, sharp returns. Route radii and contours to template. Repair or reject defective and inaccurate work.

H. Warranty: The manufacturer shall warrant to the Owner that the manufacturer will repair or replace (at his/her option), without charge, such product that fails because of a manufacturing defect during the first 10 years after initial installation. This includes all labor charges needed to repair or replace the product covered hereunder.

2.11 FABRICATION - GENERAL

A. Provide lumber framing for architectural woodwork, complete with all bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.

B. Do all fabrication from field measurement with provision for scribing as required to meet built-in conditions.

C. Coordinate the work of this Section with the work of other trades.

D. Fabricate units in largest practicable sections. Assemble in the shop for trial fit, disassemble for shipment and reassemble with concealed fasteners.

E. Maintain relative humidity and temperature during fabrication, storage and finishing operations matching that of the areas of installation.

F. Details indicate the required type and quality of construction. Modifications to conform to manufacturer’s standards will be considered provided that they comply with the Contract Documents and maintain the profiles shown, subject to acceptance by the Architect.

G. Reinforcing shown is minimum. Provide additional reinforcing as required to ensure a rigid assembly. Exposed surfaces shall be free from dents, tool marks, warpage, buckle, glue and open joints, or other defects affecting serviceability or appearance. Accurately fit all joints, corners, and miters. Conceal all fasteners. Make threaded connections up tight so that threads are entirely concealed.

H. Factory finish all items where possible. Defer final touch-up, cleaning and polishing until after delivery and installation.

I. Comply with AWI, Premium Grade, for sanding, filling countersunk fasteners, back priming and similar preparations for the finishing of architectural woodwork, as applicable to each unit of work.

J. Prepare all countersunk wood screw attachments for wood plugs. Wood plugs shall match surrounding species and grain direction; putty filling is not acceptable.

2.12 FABRICATION - SPECIFIC ITEMS

A. Millwork

1. Include all preparations for mechanical, electrical, telephone and plumbing work required.

2. Provide cabinet hardware for millwork as shown.

3. Provide dust panels in body webs and between drawer units.

4. Provide plastic laminate for exposed surfaces as specified herein before.

5. Hollow core doors will not be permitted.

6. Provide drawers with slides as specified. Drawers shall not rest on web body frames.

B. Closet and Storage Shelving

1. Provide closet and storage shelving in accordance with AWI, Custom Grade, unless otherwise shown or specified.

2. Exposed edges shall have hardwood edge bands.

C. Standing and Running Trim: Provide standing and running trim of the sizes, profiles, species, and finish as specified or shown and complying with AWI Section 6, Premium Grade.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where architectural woodwork is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 FRAMING

A. Use specified framing lumber, sizes and spacing as indicated on drawings and as required to support loads.

B. Framing shall be cut square on bearings, closely fitted, accurately set to required lines and levels, rigidly secured in place at bearings and connection with nails, lag screws and/or bolts as required by conditions.

3.3 GROUNDS, BLOCKING, NAILERS, AND FURRING

A. Provide all wood grounds, blocking, nailers, furring, and the like for work of this Section, where shown and where required, dressed to size indicated or required to suit the condition. Install grounds, blocking, nailers, furring, etc., rigidly, in proper alignment, trued with a long straight edge.

3.4 ROUGH HARDWARE

A. Provide all rough hardware, such as nails, screws, bolts, anchors, hangers, clips, and similar items. Hardware shall be of the proper size and kind to adequately secure the work together and in place, in a rigid and substantial manner. Use galvanized hardware at exterior walls, and at other locations where subject to moisture or where water will be present.

B. Secure wood to concrete and to solid masonry with countersunk bolts in expansion sleeves or other approved manner, to steel with countersunk bolts, to hollow masonry and to drywall with heavy duty countersunk toggle bolts. Space fastenings not more than sixteen (16) inches apart. Hardened cut nails, power-driven fastenings, or other suitable devices may be used where approved by the Architect.

C. Connections and fastenings shall be made in such manner as will compensate for swelling and shrinkage and shall permit the work to remain permanently in place without any splitting or opening of joints.

3.5 INSTALLATION OF CABINET FINISH HARDWARE

A. All items of finish hardware furnished under this Section shall be carefully fitted and secured in place as part of the work of this Section. Locations and positioning of hardware shall be subject to the Architect’s approval. Care shall be taken not to mar or damage hardware, or other work. Install doors plumb and true. Hardware shall be fitted to assure operation without forcing.

B. After preliminary fitting of hardware, the Contractor shall remove trim for painting and finishing work; after which he shall reinstall the hardware in a permanent manner.

C. Upon completion of the work, before final acceptance of the building by the Owner, the Contractor shall, in the presence of the Architect, show that all hardware is in satisfactory working order; fit all keys in their respective locks and, upon acceptance of the work, shall tag and deliver all keys to the Architect and Owner.

D. When directed by the Owner, at any time during the first year after the completion of the Contract, the Contractor shall return to the building and adjust and refit the work and hardware and leave such items in satisfactory working order.

3.6 GENERAL INSTALLATION

A. Wall anchorage and general installation procedures for cabinetry work shall conform to AWS Section 10, Article entitled "EXECUTION," Sub-Article 6.1, with all related sub-paragraphs.

B. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including countertops), and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offset in revealed adjoining surfaces.

C. Scribe and cut work to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation.

3.7 WOOD TRIM

A. Install with minimum number of joints possible, using full-length pieces for each run. Stagger joints in adjacent and related members. Cope at returns, miter corner.

B. Joints of all trim and/or moldings shall be set tight, miter exterior angles and cope interior angles. Joints, except end joints less than twelve (12) feet apart, will not be permitted in straight runs of trim and/or moldings and rails.

C. Secure all trim and/or moldings with glue and blind nail with finishing nails. Set exposed nail heads in finished work and putty. Sand all work to remove any tool marks and irregularities.

D. Wood shall receive finish as specified in Section 099000, "Painting and Finishing."

3.8 CLOSET AND STORAGE SHELVING

A. Provide closet and storage shelving at the locations shown. Provide hang rods where shown. Set adjustable center hangers.

3.9 CABINET WORK AND MILLWORK

A. General

1. Materials and workmanship shall conform to the Quality Standards of the Architectural Woodwork Institute specified herein and to the drawings.

2. Cabinet work and millwork shall be performed by an experienced cabinet work and millwork company, having craftsmen skilled in their trade.

3. Fabricate all cabinet work and millwork completely in the shop, in complete and/or as large units as practical, leaving only fitting, assembly, installation and a minimum of fabrication and finishing to be done at the building. Assembled work shall be rigidly secured and permanently fastened together with concealed fasteners.

4. Afford Architect every facility for inspection of work at shop or mill at such times as the Architect may select.

5. As far as practicable, use concealed fastenings for joining and assembling the work. Where this is impossible, the means of securing shall be placed in inconspicuous places and methods of joining and assembling submitted for Architect’s approval prior to fabrication.

6. Mill all finish wood accurately to detail, with clean cut moldings, profiles, and lines, machined, sanded smooth, housed, jointed, blocked, put together in the best manner, with provision for swelling and shrinkage, and to assure the work remaining in place without warping, splitting or opening of joints.

7. Cut trim to dimensions and profiles shown, from solid stock.

8. Make all trim and the like in single lengths wherever possible; joints mitered, glued, and splined. Continuous members shall have tight flush joints, doweled or splined and glued.

9. Make all joints hairline tight, fitted accurately and joined with hardwood splines or dowels, glued together, or by other method approved by Architect. Use screws, not nails, for fastenings.

10. Gluing shall, where practicable, be by the hot plate press method and glued surfaces shall be in close contact throughout. Glue stains on finished work will not be permitted.

11. Cover surface fastenings, where permitted, with matching wood plugs or wood putty. Finish exposed edges of plywood with matching solid stock. Lock miter external corners; tongue and groove internal corners to allow for contraction and expansion.

12. Machine sand with grain, finish with hand sanding, leave exposed surfaces free from machine or tool marks that will show through the finish.

13. Work which adjoins drywall, concrete, or other finish shall be fitted and scribed in a careful manner and ample allowance shall be given for cutting and scribing.

14. Erect work true to lines, levels, and dimensions, square, aligned and plumb, securely and rigidly fastened in place.

B. Cabinet Work: Provide all items of cabinet work indicated on drawings and as herein specified.

1. Tops, sides, backs, bottoms, dividers, shelves, fronts, doors, and drawer fronts shall be of plywood or flakeboard core, with the specified wood veneer or plastic laminate as indicated on drawings.

2. Drawer sides and backs shall be 1/2" thick solid clear selected white birch, suitable for clear finish. Drawer bottom shall be 3/8" thick plywood with clear selected white birch veneers, suitable for clear finish.

3. Cabinet doors and drawers shall be flush mounted.

4. Adjustable shelves in cabinets shall have grommets spaced 2" o.c.

5. Fixed shelves shall be dadoed into side supports and glued.

6. Shelves shall be 3/4" thick for spans up to 30"; for spans in excess of 30" to 48" shelves shall be 1" thick.

7. All cabinets shall have closed top, sides, bottom, and back with veneers to match face work. Cabinets to fit accurately into indicated locations; scribe moldings permitted only where indicated.

8. Countertops, counters, counter fronts, shelves, etc., indicated on drawings to have plastic laminate, shall have plastic laminate shop applied to 3/4" thick core, with plastic laminate backing sheet on underside or back of countertops, counters, and shelves. Plastic laminate shall be pressure laminated to core with laminate at

external corners. Provide concealed wood framing to support plastic laminate counters, securely fastened to wall and to underside of counters.

C. Countertops shall be installed to support a minimum concentrated live load of 150 lbs. acting downward at mid span at outer edge of counter without causing deformation and damage.

3.10 PAINTING AND FINISHING

A. General: All painting and finishing work of this Section shall be shop applied, unless otherwise noted, as specified below. All painting and finishing shall match approved samples. Field finish painting, where specified below, shall be by painting Subcontractor, as specified for in Painting Section.

B. Back-Painting: All work of this Section in contact with concrete or masonry or other moisture areas and all concealed surfaces of cabinet and millwork, shall be back-painted with one (1) coat of oil-based paint prior to installation, shop applied where practicable.

C. Field Touch-Up: Field touch-up shall be the responsibility of the installing Subcontractor and shall include the filling and touch-up of exposed job made nail or screw holes, refinishing of raw surfaces resulting from job fitting, repair of job inflicted scratches and mars, and final cleaning up of the finished surfaces.

3.11 CLEAN UP AND PROTECTION

A. Clean Up: At regular intervals during the course of the work, all debris and excess material shall be cleaned up and removed from the site. Upon completion of installation, clean all spaces of debris caused by woodwork installation.

B. Protection: Protect all woodwork from marring, defacement of other damage until final completion and acceptance of the project by the Owner. Repair or replace all defective units prior to final inspection as directed by the Architect. Any units that cannot be satisfactorily repaired in the opinion of the Architect shall be replaced with new units of same original design, at no additional cost to the Owner.

END OF SECTION

SECTION 068316

FIBERGLASS-REINFORCED PANELING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the fiberglass-reinforced paneling as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Fiberglass-reinforced paneling.

2. Moldings.

1.3 RELATED SECTIONS

A. Gypsum Drywall - Section 092900.

1.4 QUALITY ASSURANCE

A. Installer: A firm that has at least three years' experience in work of the type required by this section and that is acceptable to the manufacturers of the primary materials.

B. Source: Provide plastic panels that are the products of one manufacturer. Provide secondary materials, moldings and accessories that are acceptable to the panel manufacturer.

C. In-Place Samples: Before beginning primary work of this section, provide typical in-place samples of each item and type of work at locations acceptable to the Architect and obtain the Architect's acceptance of visual qualities.

1. Size of Sample: Not less than 32 square feet.

2. Intent of Sample: The intent of the in-place sample is to obtain approval of a typical installation as early as possible so that problems, if any, can be corrected before the problem is repeated.

3. Sample Disposition: Acceptable in-place samples may be incorporated into the finished work. Protect and maintain acceptable in-place samples throughout the work of this section to serve as criteria for acceptance of the work.

D. Burning Characteristics: Provide materials whose surface burning characteristics, when tested in compliance with ASTM E 84 are classified as Class A or Class 1.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.

B. Initial Selection Samples: Submit minimum 3" x 3" samples showing complete range of colors, textures, and finishes available for each material used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from all possible damage. Sequence deliveries to avoid delays, but minimize on-site storage.

PART 2 PRODUCTS

2.1 FIBERGLASS PLASTIC PANEL SYSTEM

A. Products: Provide "Standard FRP" as manufactured by Marlite, or comparable product by Crane Composites, Inc., Glasteel Fiberglass Reinforced Panels, Division of Stabilit America, Inc., Nudo Products, Inc., or approved equal.

B. Panel Characteristics: Provide one of the specified products having the following characteristics:

1. Thickness: 3/32".

2. Texture: Smooth.

3. Panel Size: 4' x 8'.

4. Colors: Provide panels and matching moldings and rivets; S 100G White.

C. Moldings: Provide vinyl moldings as recommended and approved by the panel manufacturer.

D. Panel Fasteners: Provide nylon rivets recommended by manufacturer for installing reinforced plastic panels to gypsum drywall and metal stud substrates. Do not use any metal in rivets.

E. Accessories: Provide all necessary sealants, components and accessories as recommended by panel manufacturer for a complete, sanitary, easy-to-clean installation. Use only sanitary, mold inhibiting USDA approved silicone sealant.

PART 3 EXECUTION

3.1 INSTALLATION

A. Pre-Installation Examination Required: The Installer shall examine previous work, related work, and conditions under which this work is to be performed and notify Contractor in writing of all deficiencies and conditions detrimental to the proper

completion of this work. Beginning work means Installer accepts substrates, previous work, and conditions.

B. Manufacturer's Instructions: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.

C. Installation: Mechanically attach panels to substrates indicated using non-metallic rivets at spacing recommended by panel manufacturer. Provide expansion clearance at all panel edges as required by manufacturer, but make sure moldings cover panel edges. Gaps are not permitted.

1. Trim and Molding: Provide moldings at all edges, joints, seams and corners. Provide moldings having the easiest to clean shapes and profiles available.

2. Sealing: Seal all edges, joints, seams, and corners as the work progresses.

D. Tolerances: The following allowable installed tolerances are allowable variations from locations and dimensions indicated by the Contract Documents and shall not be added to allowable tolerances indicated for other work.

1. Allowable Variation from True Plumb, Level, and Line: ± 1/8" in 20'-0".

2. Allowable Variation from True Plane: 1/8" in 10'-0".

3.2 CLEANING AND PROTECTION

A. Cleaning: Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned or repaired.

B. Protection: Provide temporary protection to ensure work is without damage or deterioration at time of final acceptance. Remove protections and re-clean as necessary immediately before final acceptance.

END OF SECTION

SECTION 071113

BELOW-GRADE DAMPPROOFING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the below-grade dampproofing as shown on the drawings and/or specified herein, including but not limited to, the following:

1. Dampproofing applied to exterior side of foundation walls.

2. Protection board.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Earthwork - Section 312000.

1.4 SUBMITTALS

A. Product data for each type of product specified, including data substantiating that materials comply with requirements for each dampproofing material specified. Include recommended method of application, recommended primer, number of coats, coverage or thickness, and recommended protection course.

B. Certification by dampproofing manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site, ready for use in the manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name, and manufacturer's name. Delivered materials shall be identical to approved samples.

B. Store materials under cover in a dry and clean location, off the ground. Remove materials which are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials.

1.6 JOB CONDITIONS

A. Environmental Requirements: Dampproofing materials shall not be installed on wet surfaces, or when the temperature is 32 deg. F. and falling.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide trowel grade mastic manufactured from a blend of selected asphalts, stabilizers, fibers and solvents in compliance with ASTM D 4586, Type 1, (non-asbestos) equal to Karnak 86 AF manufactured by the Karnak Corp. or equal made by Sonneborn, Anti-Hydro or approved equal.

B. Priming Material: Applied to the concrete surfaces prior to the installation of the dampproofing, as required and/or recommended by the manufacturer.

C. Protection Boards: For the protection of the dampproofing after installation and before backfilling: provide 1/8" thick, multi-ply, semi-rigid board, consisting of a mineral stabilized asphalt core sandwiched between layers of asphalt saturated felt, and faced on one side with polyethylene film.

1. W.R. Meadows Inc.

2. Sonneborn.

D. Glass Fabric: Woven glass fabric, treated with asphalt, complying with ASTM D 1668, Type I.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where below-grade dampproofing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Surfaces to Receive Dampproofing: Clean, dry, smooth and free from surface treatments which may inhibit the bond of the dampproofing. Treat imperfections in these surfaces such as large cracks, honeycombs and holes prior to the dampproofing application, by repair work consisting of filling with cement, or as directed.

B. Install separate flashings and corner protection stripping, as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirements at building expansion joints, if any.

C. The start of the dampproofing installation shall imply acceptance of those surfaces, and conditions encountered in the field, to install the work, as recommended and as specified.

3.3 INSTALLATION

A. Perform the work using skilled workmen in accordance with the acceptable manufacturer's instructions and directions.

B. Prime surfaces to receive dampproofing using Karnak No. 108 primer, as recommended by the manufacturer, carefully following label instructions as to rate of coverage.

C. Apply two (2) coats of dampproofing continuously, at a rate of 6 gallon/100 sq. ft. per coat.

D. At changes in plane or where otherwise shown as "reinforced", install lapped course of glass fabric in first coat of dampproofing compound before it thickens.

E. Install 2" x 2" cant strip of bituminous grout at base of vertical dampproofing where it meets horizontal surface.

F. Apply vertical dampproofing down walls from finished grade line to top of footing, extend over top of footing, and down a minimum of 6" over outside face of footing. Extend 12" onto intersecting walls and footings, but do not extend onto surfaces exposed to view when the Project is completed.

G. Protect the installed dampproofing by embedding the protection boards into the dampproofing when the dampproofing becomes tacky, or as recommended by the manufacturer.

3.4 PROTECTION

A. Protect surfaces adjacent to the dampproofing operations against staining or other damage during the work of this Section.

B. Staining or soiling which does occur to the adjacent materials shall be removed as the work progresses, including smear, spills or displaced materials. Leave installed work in a neat condition upon completion.

C. Backfilling against completed dampproofing shall not occur for at least 72 hours.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify areas to receive telescoping gym seats are free of impediments interfering with installation and condition of installation substrates are acceptable to receive telescoping gym seats in accordance with telescoping gym seats manufacturer's recommendations. Do not commence installation until conditions are satisfactory.

3.2 INSTALLATION

A. Manufacturer's Recommendations: Comply with telescoping gym seats manufacturer's recommendations for product installation requirements.

B. General: Manufacturer's Certified Installers to install telescoping gym seats in accordance with manufacturer's installation instructions and final shop drawings. Provide accessories, anchors, fasteners, inserts and other items for installation of telescoping gym seats and for permanent attachment to adjoining construction.

3.3 ADJUSTMENT AND CLEANING

A. Adjustment: After installation completion, test and adjust each telescoping gym seats assembly to operate in compliance with manufacturer's operations manual.

B. Cleaning: Clean installed telescoping gym seats on both exposed and semi-exposed surfaces. Touch-up finishes to restore damage or soiled surfaces.

3.4 PROTECTION

A. General: Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer to ensure telescoping gym seats are without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 071326

SHEET MEMBRANE WATERPROOFING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the sheet membrane waterproofing as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Sheet membrane waterproofing for foundation wall surfaces.

2. Sheet membrane waterproofing for under-slab conditions.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Earthwork - Section 312000.

1.4 QUALITY ASSURANCE

A. Preinstallation Conference: Approximately 2 weeks prior to scheduled commencement of waterproofing installation, meet at Project site with Waterproofing Installer; preparer of substrate to receive waterproofing; installers of other work in and around waterproofing that must precede, follow, or penetrate waterproofing (including Mechanical and Electrical Installers as applicable); Architect; Owner; and waterproofing manufacturer's representative to review materials, procedures, schedules, and other requirements and conditions related to installing waterproofing.

B. Qualifications of Subcontractors

1. Subcontractors: All work of this Section shall be performed by a subcontractor who is approved by the manufacturer of the waterproofing material.

2. Qualifications of Subcontractors: Subcontractors shall submit evidence of being bona fide waterproofing subcontractors, for a period of not less than five (5) years, and that they are approved by the manufacturer of the waterproofing material for the installation of the manufacturer’s material in accordance with the requirements of this Section.

a. Subcontractor shall submit a letter from manufacturer of waterproofing material stating that subcontractor is approved by the manufacturer for the application of the waterproofing systems specified and accepted for use on the Project.

b. Letter shall certify that the subcontractor has previously and satisfactorily applied the waterproofing systems specified herein on jobs of similar size and scope, under manufacturer's supervision.
c. Letter shall be on manufacturer's letterhead and shall be signed by an officer of the company, not by a local sales representative.

C. Manufacturer's Representative/Contractor's Certification

1. Representative of the waterproofing material manufacturer shall be required to provide field instructions and supervision for the installation of the waterproofing systems at the start of the work of this Section.

2. The manufacturer's representative shall be required to make sure that the workmen for waterproofing systems on the site of the Project are fully instructed and trained in the handling and application of all the materials and shall see that all the materials are correctly installed.

3. Upon completion of the Installation, submit to the Architect written certification that the representative of the manufacturer of the waterproofing material has supervised the work of this Section and that all materials were correctly installed.

1.5 SUBMITTALS

A. Shop Drawings: Typical installation details, showing details at flashings, at terminations, at joints, at intersection of horizontal and vertical surfaces, and at penetrations in membrane system.

B. Samples - Submit

1. Membrane, 6" x 6" samples of each membrane.

2. 6" x 6" sample of flashing.

3. 6" x 6" sample of drainage board.

C. Manufacturer's Literature: Submit manufacturer's technical, safety data sheets, and installation literature for all materials of this Section. Submit Independent Test data indicating that membrane meets properties specified herein.

D. General Contractor's Certification: Submit per Article 1.4.

1.6 STORAGE OF MATERIALS

A. All materials shall be stored in their original tightly sealed containers or unopened packages; shall be clearly labeled with the manufacturer's name, brand name and number, and batch number of the material with expiration date where appropriate.

B. Materials shall be stored in a neat and safe manner so as not to exceed the allowable live load of the storage area.

C. Material shall be stored out of the weather in a clean, dry area.

D. Liquid materials, such as adhesives, thinners, and primers, shall be stored in areas away from sparks, open flames, and excessive heat.

1.7 JOB CONDITIONS

A. No application of waterproofing shall commence or proceed during inclement weather, or the threat of imminent precipitation.

B. All surfaces to receive the system shall be thoroughly dry and free of dew or frost.

C. Materials shall be stored until time of mixing at temperatures above 60 deg. F. to maintain a consistency suitable for mixing. Do no work below 40 deg. F.

D. Prior to and during application, all dirt and dust shall be removed from surfaces either by vacuuming, sweeping, blowing with compressed air, or similar methods.

E. Surfaces not designated to receive the system shall be properly masked or otherwise protected against accidental spillage or application of the material to those areas.

1.8 PROTECTION

A. Against Loads: Protect work of this Section against concentrated loads and any other loads or equipment that would damage the materials or work.

B. Against Traffic: Do not permit traffic on horizontally installed work of this Section, except for workmen doing the work, during the installation, and after the installation until membrane systems are covered with protective boards or with the specified finishing materials.

C. Against Damage: Protect vertically installed work of this section from damage by reinforcing and placement.

1. Take and maintain necessary preventive measures to protect work of this Section from damage until Project is accepted.

2. Rejection of Damaged Work

a. Damaged materials or work will be rejected.
b. Rejected materials or work must be immediately removed and replaced with new materials.

1.9 FIELD QUALITY CONTROL

A. Construction Traffic:

1. Limit construction traffic over completed membrane.

2. General Contractor shall provide 1/2 in. plywood protection layer, where construction traffic is unavoidable.

B. Inform Architect in writing on a daily basis of any of the following events. State specific location of each occurrence.

1. Buckling to the Waterproofing and other deformations as a result of ground water events.

2. Leakage through the finished waterproofing installation.

3. Damage by other trades.

C. Provide Manufacturer's Representative's report (prior to backfill) stating that the waterproofing has been inspected and is acceptable and eligible for manufacturer's warranty.

1.10 WARRANTY

A. The manufacturer of the waterproofing system executed under this Section warrants the waterproofing system to be watertight and free from defects in materials and workmanship for a period of ten (10) years from date of acceptance of this Contract, and that he, agrees to promptly make repairs or replace defective waterproofing materials during the warranty period.

B. Contractor's One-Year Workmanship Warranty: Provide a written warranty for all work of this Section, stating that if, within one year after the Owner's acceptance of the Work, any of the work is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly after receipt of a written notice from the Owner to do so. The warranty shall state that the Contractor shall bear all costs incurred by the Owner, including reasonable attorney's fees, to enforce compliance with the obligations of this warranty, and will replace any material or system that requires repeated maintenance or repair to function effectively. The obligation of this warranty shall run directly to the Owner and may be enforced by the Owner against the Contractor, shall survive the termination of the Contract and shall not be limited by Conditions other than this Contract.

PART 2 PRODUCTS

2.1 WATERPROOFING MEMBRANE

A. Trade names used herein for membrane waterproofing are those of GCP Applied Technologies. Other acceptable manufacturers will be Carlisle Coatings and Waterproofing (CCW), Henry Company or approved equal.

B. For foundation walls, provide "Bituthene 4000" sheet waterproofing membrane, 60 mils thick and "Liquid Membrane," 60 mils thick, for flashing, as manufactured by GCP Applied Technologies or approved equal.

C. At under-slab conditions, provide adhesive coated HDPE Composite Sheet "Preprufe 300R Plus" system by GCP Applied Technologies or approved equal.

1. HDPE membrane or reinforced TPO membrane shall have a protective layer to protect the membrane from the weather and U.V. for up to 56 days before casting concrete against it.

D. Primer/Conditioner: "Bituthene 4000" latex/water-based primer specifically formulated to provide adhesion of Bituthene Waterproofing Membranes.

1. If water-based primer does not provide sufficient adhesion to substrate, substitute Bituthane Primer B-2 solvent-based primer.

E. Mastic: "Bituthene Elastomeric Mastic" rubberized-asphalt base mastic.

F. Tape: Double sided synthetic adhesive tape equal to "Preprufe LT" and "HC."

G. Protection Board: 1/4" thick semi-rigid protection board, "Bituthene Asphaltic Hardboard."

H. Liquid Membrane: "Bituthene Liquid Membrane" two-component 100% solids trowel grade asphalt modified urethane.

I. Drainage Board/Composite: Prefabricated dimpled polystyrene drainage core with a non-woven filter fabric on one side and a polymer film on the reverse side.

1. Vertical Applications

a. "Hydroduct 220" by GCP Applied Technologies.
b. Or approved equal.

2. Horizontal Applications

a. "Hydroduct 660" by GCP Applied Technologies.
b. Or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where sheet membrane waterproofing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work. Starting of work implies acceptance of substrate.

3.2 PREPARATION OF SURFACES TO RECEIVE WATERPROOFING

A. Conform to the requirements of specified manufacturer.

B. Earth or crushed stone substrates shall be compacted to produce an even, sound substrate. Loose aggregate, sharp protrusions and standing water shall be removed.

3.3 INSTALLATION OF FOUNDATION WALL WATERPROOFING

A. General: Conform to recommendations and published specifications of the manufacturer' including environmental requirements and preparation requirements to receive waterproofing.

B. Foundation Walls

1. General: The membrane, when in place must withstand a minimum static ground water pressure of 150 feet.

2. Priming: Application of primer shall be limited to what can be covered with Bituthene Waterproofing Membrane in a given work day. Primed areas not covered by membrane during the work day will be reprimed. Apply primer by spray, roller or brush at a rate of 250 - 350 sq. ft. per gallon. Roller shall be natural material such as lamb's wool, having a nap of approximately one inch. Primer

shall be applied to a clean, dry, frost-free and dust-free surface. Sufficient primer must be used on the day surface to condition it to a dust-free state suitable for the application of Bituthene Waterproofing Membranes.

a. Bituthene 4000 Surface Conditioner should not be applied below 25 deg. F. on vertical surfaces. Allow primer to dry 30 minutes. Conditioner is considered dry when the substrate returns to its original color.
b. Re-prime areas that become dusty or dirty prior to membrane installation.

3. Membrane Installation: Apply Bituthene Waterproofing Membrane vertically in sections of 8' in length or less. On higher walls apply two or more sections with the upper overlapping the lower by a least 2-1/2". Press all membrane in place with heavy hand pressure or rollers during application.

4. Sealing Edges: Bituthene Waterproofing Membrane shall be applied over the edge of the slab or over the top of the foundation or parapet wall. If the membranes are terminated on the vertical surface, a reglet or counter flashing may be used or the membrane may be terminated directly on the vertical surface by pressing very firmly to the wall. Press edges with a metal or hardwood tool such as a hammer or knife handle. Apply a troweled bead of Bituthene Mastic to all vertical and horizontal terminations. Bituthene Liquid Membrane can be used as an alternative method at the General Contractor's option.

5. Sealing Seams: All edges and end seams must be overlapped at least 2-1/2". Apply succeeding sheets with a minimum 2-1/2" overlap and stagger end laps. Roll or press the entire membrane firmly and completely as soon as possible. Patch misaligned or inadequately lapped seams with Bituthene Membrane. Slit any fish mouths, overlap the flaps, and repair with a patch of Bituthene and press or roll in place. The edges of the patch shall be sealed with a troweling of mastic. Laps within 12" of all corners shall be sealed with a troweling of mastic.

6. Corner Forming: Outside corners must be free of sharp edges. Inside corners shall receive a fillet formed with Liquid Membrane, latex modified cement mortar equal to Daraweld C made by Grace mixed with cement mortar or epoxy mortar. Do not use fiber or wood cants. One of two methods may be used for treating corners at the General Contractor's option:

a. Apply Bituthene Liquid Membrane 6" in each direction from the corner and form a fillet with a minimum 3/4" face.
b. Install an 11" minimum strip of Bituthene Membrane centered on the corner. Install Bituthene Membrane over the treated inside and outside corners.

7. Over waterproofing, apply drainage composite board by adhering board to cured membrane using tape or adhesive per manufacturer’s recommendations; lap all edges 4” and conform to the following:

a. Install drainage layer directly over the membrane. Start at the low points on the wall and shingle all laps to the flow of water.
b. Splice drainage panels together by butting longitudinal edges of adjacent sheets and peeling back fabric to expose the cores of the panels. Install precut "lock strips" consisting of 4 dimple x 5 dimple sections of the drainage panel centered on the joint between the panels and spaced every 10

dimples along the length of the joint. Snap dimples of lock strip to dimples of each panel and reattach fabric over the panel joint.

c. Cut the core of the drainage panels around penetrations and cut an 'X' in the filter fabric and tape the fabric to the sides of the penetration.

d. Cover all terminal edges of the drainage composite with an integral fabric flap by tucking the fabric around the edge of the core and adhering the fabric to the bottom of the core.

3.4 INSTALLATION OF BELOW-GRADE, UNDERSLAB WATERPROOFING

A. General: Install adhesive coated HDPE composite sheet according to waterproofing manufacturer's written instructions.

B. Preparation

1. Surfaces to receive blind side membranes must be smooth and sound, with no gaps or voids in excess of 1/2 in. Earth and stone substrates must be compacted to produce an even, solid substrate. If required by membrane manufacturer, provide an additional layer of underlayment protection board over sharp or angular stone substrates. Surfaces to receive waterproofing shall be thoroughly dry and free of moisture.

2. General: Comply with manufacturer's instructions for preparing surface including joint or crack treatment.

3. Apply primer to substrate surfaces at rate recommended by manufacturer of primary waterproofing materials. Prime only area that will be covered by waterproofing membrane in same working day. Reprime areas not covered by waterproofing membrane within 24 hrs.

C. Underslab Applications

1. Apply Hydroduct 660 drainage composite board as recommended by manufacturer over the compacted sub-grade.

2. Apply the membrane over the drainage composite board with the HDPE side facing the drainage composite board and the treated white coating surface facing the concrete to be poured. The membrane may be installed at any convenient length. Apply succeeding sheets by overlapping previous sheets 3" along the self-adhesive edge of the membrane. Remove the silicone coated release liner covering the membrane and roll the side lap to assure a tight seal.

3.5 SEAM REINFORCEMENT FOR HDPE COMPOSITE SHEETS ONLY

A. Provide a 6 in. strip of modified bituminous sheet membrane (Bituthene 4000) centered behind all laps.

B. At locations where a salvage edge is not present and at end laps, lap sheets 6 in., apply a 1/8 in. thick by 6 in. wide application of liquid membrane between sheets, to provide a 6 in. wide seal.

C. Integration of old onto new pre-applied sheet membrane.

1. Integration of Sheet Membrane onto Sheet Membrane that has been installed in excess of 30 days prior

    a. Lap sheets 12 in., apply a 1/8 in. thick by 12 in. wide application of fluid membrane between sheets, to provide a 12 in. wide seal at this location.
    b. Install Waterproofing Tape centered at edge of lap and roll firmly into place with an approved roller.
    c. Install additional Waterproofing Tape to cover white film that has been installed over 30 days prior.

2. Repair of pre-applied sheet membrane

    a. Scratch on white coating exposing underlying black surface of Sheet Membrane. Install Waterproofing Tape at areas where the white coating of the membrane is damaged, including boot scuff marks and abrasions by rebar.
    b. Damage or Puncture of Sheet Membrane: Install Patch of short Membrane set in Liquid Membrane. Patch must extend 3 in. in every direction around extent of damaged area. Install Waterproofing Tape centered over the edge of the patch. If the damaged area does not have 5 in. of sound material around it, inject Liquid Membrane into puncture until Liquid Membrane backs out, and proceed with patch as space allows.

3.6 CLEAN-UP

A. Upon completion of the waterproofing system, the General Contractor shall remove all equipment, material and debris from the work and storage area, and leave those areas in an undamaged and acceptable condition.

END OF SECTION

SECTION 071416

COLD-FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the cold-fluid-applied waterproofing as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Preparation of surfaces to receive cold-fluid-applied waterproofing.

2. Cold-fluid-applied waterproofing system shall consist of liquid membrane waterproofing, reinforcing flashings at corners, joints, penetrations, curbs and drains, and protection board over membrane.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Drains - Division 22.

1.4 SUBMITTALS

A. Shop Drawings - submit for: Typical installation details, showing details at drains, at reinforcing flashings, at terminations, at joints in structure below, at intersection of horizontal and vertical surfaces, at penetrations in membrane systems.

B. Samples - submit:

1. Cold-fluid-applied waterproofing membrane, cured sample.

2. Sheet flashing material, 12" x 12".

3. Protection board, 12" x 12".

C. Manufacturer's Literature: Submit manufacturer's technical and installation literature for all materials of this Section; including data indicating that material meets ASTM C836.

D. Contractor's Certifications: Submit per Article 1.8.

E. Subcontractor's Qualifications: Submit per Article 1.9.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Materials shall be delivered to the project site in manufacturer's unopened containers with manufacturer's brand name clearly marked thereon.

B. Storage: Store containers of material on end on wood or other clean, rigid pan to prevent adherence of foreign material. Roll goods shall be stored on end in unopened packages. Storage area shall be away from excessive heat and open flame. Temperature of storage area for surface conditioner shall be above 40 deg. F.

1.6 ENVIRONMENTAL CONDITIONS

A. Weather: No waterproofing shall be applied in wet weather or on wet surfaces.

B. Temperature: Surface and air temperature shall be as recommended by manufacturer of the materials being installed.

1.7 PROTECTION

A. Against Loads: Protect work of this Section against concentrated loads and any other loads or equipment that would damage the materials or work. Use boards or other approved means to safely distribute the loads.

B. Against Traffic: Do not permit traffic on work of this Section except for workmen doing the work, during the installation and after the installation, until covered with protective boards or with the specified finishing materials. Take necessary preventive measures to protect work of this Section from damage during and after application, until traffic is permitted.

C. Rejection of Damaged Work

1. Damaged materials or work will be rejected.

2. Rejected materials or work must be immediately removed and replaced with new materials, at the contractor's expense.

1.8 MANUFACTURER'S REPRESENTATIVE

A. Contractor shall require representative of the manufacturer of the liquid membrane waterproofing material to provide field instructions and supervision for the installation of the complete liquid membrane waterproofing system at the start of the work of this Section.

B. Contractor shall require the manufacturer's representative to make sure that the Subcontractor's workmen are fully instructed and trained in the handling and application of all the materials and shall see that the materials are correctly installed.

C. Upon completion of the installation, the Contractor shall submit to the Architect written certification that the representative of the manufacturer of the liquid membrane waterproofing material has supervised the work of this Section and that all materials were correctly installed.

1.9 QUALIFICATIONS OF SUBCONTRACTORS

A. Subcontractors: All work of this Section shall be performed by an Installer who is approved by the manufacturer of the liquid membrane waterproofing materials.

B. Qualifications of Installers: Installers shall submit evidence of being bona fide waterproofing subcontractors and that they are approved by the manufacturer of the liquid membrane waterproofing material for the installation of their material and in accordance with the requirements of this Section. Installer shall submit letter from manufacturer of liquid membrane waterproofing material stating that subcontractor is approved by the manufacturer for the application of the liquid membrane waterproofing system specified for the Project. Letter shall certify that the Installer has satisfactorily applied the liquid membrane waterproofing system specified herein under the manufacturer's supervision. Letter shall be on manufacturer's letterhead and shall be signed by an officer of the company.

1.10 WARRANTY

A. The Contractor and waterproofing manufacturer shall warrant that all the liquid membrane waterproofing system executed under this Section will be watertight and will be free from defects in materials and workmanship for a period of ten (10) years from the date of acceptance of the Project. Contractor shall remedy any and all defects in the waterproofing systems during the warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cold-Fluid-Applied Waterproofing Membrane: Fluid-applied waterproofing a two-part, self-curing, solvent and bitumen free, synthetic-rubber-based material equal to "Procor" fluid applied waterproofing membrane by GCP Applied Technologies meeting or exceeding the performance requirements of ASTM C 836 and other ASTM standards as shown in the following table, or comparable product by Henry Company, Kemper, or approved equal.

B. Waterproofing Membrane Physical Properties:

1. Cured Film Thickness, ASTM D 3767 Method A: 1.5 mm (0.060 in.) nominal.

2. Solids Content, ASTM D 1644: 100%,

3. Flexibility, 180° bend over 25 mm (1 in.) mandrel at -32° C (-25°F), ASTM D 1970: Unaffected.

4. Elongation, ASTM D 412: 500% minimum.

5. Peel Adhesion to Concrete, ASTM D 903 Modified 1: 880 N/m (5 lb./in.).

C. Prefabricated Drainage Composite: Hydroduct 660 Drainage Composite by Grace Construction Products.

D. Miscellaneous Materials

1. Flashing/ Primer/ Filler/ Sealer: As recommended by manufacturer of liquid membrane waterproofing compound.

2. Cant Strips, and Accessories: As recommended by manufacturer of waterproofing compound.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where cold-fluid-applied waterproofing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected to permit proper installation of the work.

3.2 PREPARATION

A. Condition of Surfaces: Surfaces to receive waterproofing shall be free of defects or conditions that will interfere with, or prevent, a satisfactory installation of waterproofing. Concrete shall be at least 28 days old.

B. Contaminants

1. Surfaces shall be thoroughly cleaned and shall be free of water, dew, frost, dust, dirt, oil, grease, concrete curing compounds, laitance, and other foreign matter. If cleaning method used by contractor is not satisfactory to waterproofing material manufacturer, then Contractor shall clean concrete substrate by sand blasting to remove laitance, concrete curing compounds, and other contaminants.

2. Dirt and dust shall be removed with an air compressor or industrial type vacuum cleaner, or methods approved by waterproofing material manufacturer.

C. Repairs: Voids, cracks, holes, and other damaged surfaces shall be repaired by trades involved before application of membrane.

D. Other Work: Installation of other work passing through or concealed by waterproofing shall be complete and approved by Contractor before starting work.

E. Expansion Joints: Joints shall be sharply formed and free of broken edges or loose aggregates. Joints shall be free of preformed joint fillers, sealants or back-up materials to a depth which is at least twice the width of the joint.

F. Start of Work: The beginning of application work shall imply acceptance of the surfaces to receive waterproofing for that area of this subcontractor.

G. Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown.

H. Fill voids, seal joints, and apply bond breakers as recommended by prime materials manufacturer, with particular attention at construction joints.

I. Install flashing at expansion joints, control joints, moving and non-moving cracks, protrusions through the membrane and at intersections, in accordance with approved shop drawings.

J. Prime substrate as recommended (and only if recommended) by waterproofing manufacturer. Priming is required if the porosity of the concrete is such that entrapped air may cause blisters or pinholes in the coating. Apply sealer by roller or spray application only.

K. Mask off adjoining surfaces not to receive liquid membrane waterproofing, to effectively prevent spillage or overspray of liquid materials outside membrane area.

3.3 INSTALLATION

A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.

B. Commencement of waterproofing work shall imply acceptance of the surfaces to receive waterproofing for that area by the Contractor.

C. Start installation of waterproofing membrane only in presence and with advice of manufacturer's technical representative.

D. Apply uniform coating of waterproofing to substrate and adjoining surfaces indicated to receive membrane.

1. Apply coating either by trowel or by machine spray, complying with manufacturer's recommendations regarding horizontal and vertical surfaces.

E. Mix and trowel apply membrane 120 mils.

F. For application on horizontal surfaces, use membrane designed for horizontal use; where thickness exceeds 60 mils, apply in 2 applications.

G. Liquid membrane shall overlap all flashing a min. of 3".

H. Install sheet-type elastomeric flashings and joint covers where shown and as recommended by prime materials manufacturer. Except as otherwise shown, extend flashings onto perpendicular surfaces and other work penetrating substrate to not less than 4" beyond finished surface to be applied over waterproofing.

I. Permit membrane to cure under conditions which will not contaminate or deteriorate waterproofing material. Block off traffic and protect membrane from physical damage.

J. Protection Course: Install protection course on cured membrane after testing without delay, so that period of membrane exposure will be minimized. On vertical surfaces comply with waterproofing manufacturer's recommendations for adhesion of protection course to membrane.

3.4 PERFORMANCE REQUIREMENTS

A. It is required that cold-fluid-applied waterproofing membrane be watertight and not deteriorate in excess of limitations published by manufacturer.

1. In-Place Testing: Before completed membranes on horizontal surfaces are covered by protection course or other work, test for leaks with 2" depth of water maintained for 24 hours. Repair any leaks revealed by examination of substructure, and repeat test until no leakage is observed.

3.5 CLEAN-UP

A. Upon completion of the waterproofing system, the Contractor shall remove all equipment, materials and debris from the work and storage areas and leave the area in an undamaged and acceptable condition.

END OF SECTION

SECTION 072100

THERMAL INSULATION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the thermal insulation as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Foundation wall insulation.
2. Insulation under slabs-on-grade.
3. Concealed, semi-rigid insulation.
4. Mineral wool batt insulation.
5. Fiberglass batt insulation.
6. Closed-cell, spray foam insulation.
7. Open-cell, spray foam insulation.
8. Spray-foam insulation at gaps around glazing frames, door frames, penetrations, and similar items in exterior wall assemblies for tie-in of air/vapor barrier to frames.
9. Spray-applied cellulosic insulation.
10. Attachment devices.

1.3 RELATED SECTIONS

A. Cold-Formed Metal Framing - Section 054000.

B. EPDM Membrane Roofing and Roof Insulation - Section 075323, for roof insulation.

C. Firestops and Smokeseals - Section 078413.

D. Gypsum Drywall - Section 092900, for acoustical insulation.

E. Earthwork - Section 312000.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Vertical and Lateral Fire Propagation Test Characteristics: The exterior wall assembly is required to comply with NFPA 285 "Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components." The base wall, stud cavity insulation, wall sheathing, air barrier, continuous wall rigid insulation and exterior cladding are components that are required to be to be evaluated as part of this specific assembly test. The basis of design product listed herein is a component of the design test assembly selected by the Architect.

1.5 SUBMITTALS

A. Submit product data for each type of product indicated, including re-cycled content.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site ready for use in the manufacturer's original and unopened containers and packaging, bearing labels as to type and brand. Delivered materials shall be identical to approved samples.

B. Store materials under cover in a dry and clean location, off the ground. Remove materials which are damaged or otherwise not suitable for installation and replace with acceptable materials.

C. Take every precaution to prevent the insulation from becoming wet, cover with tarps or other weather/watertight sheet goods.

PART 2 PRODUCTS

2.1 FOUNDATION WALL AND UNDERSLAB INSULATION

A. Provide extruded polystyrene board insulation equal to "Styrofoam" manufactured by Dow Chemical Co., or approved equal made by Owens Corning or PACTIV Building Products, conforming to ASTM C 578, Type IV, minimum 40 psi compressive strength, with a maximum flame spread and smoke developed indices of 75 and 450 respectively.

B. Insulation shall have an aged R value of not less than 5/inch; shall be 3" thick unless otherwise noted on the drawings.

2.2 CONCEALED SEMI-RIGID BUILDING INSULATION WITHIN STUDS

A. Provide semi-rigid mineral wool insulation equal to "Thermafiber FS-25" made by the Thermafiber Co. or equal made by Fibrex or Rockwool conforming to ASTM C 612, Type 1A and 1B faced on one side with foil scrim Kraft vapor retarder, maximum flame spread and smoke developed indices of 25 and 5 respectively.

B. Insulation shall have an R value of not less than 4.2/inch with a nominal density of 4 lbs./cu. ft.

C. Insulation shall be 2" thick unless otherwise noted on the drawings.

2.3 MINERAL WOOL BLANKET INSULATION

A. Unfaced, Mineral-Wool Batt Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; 2.5 pcf density, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

B. Reinforced-Foil-Faced, Mineral-Wool Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim Kraft, or foil-scrim polyethylene.

1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

C. Insulation shall have an R value of not less than 3.7/inch and shall be 3.5" thick unless otherwise noted on the drawings.

2.4 FIBERGLASS BLANKET INSULATION

A. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim Kraft, or foil-scrim polyethylene.

1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.5 CLOSED-CELL, SPRAY FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: "Icynene MD-C-200" spray-applied, rigid closed-cell polyurethane insulation manufactured by Icynene, or comparable product by Carlisle, Foam It Green, Johns Manville, or approved equal; 2.2 lb./cu. ft. density material per ASTM D 1622; meets Class 1 requirements of ASTM E 84.

1. R-Value shall be 6.5 per inch per ASTM C 518.

2. Bond strength shall be greater than 100 psf per ASTM E 736.

3. Product shall be Class 1 Class A per ASTM E 84/ UL 723.

4. Product shall be tested in accordance with UBC 26-2 Test Method for the evaluation of Thermal Barriers (ASTM E 119).

5. Product shall pass Full-Scale Corner Test.

6. Product shall have passed the Air Barrier Association of America (ABAA) testing and be an approved air barrier product.

7. Provide manufacturer's written certification that product contains no asbestos.

B. Thermal Barrier: DC315 thermal ignition barrier over spray-applied insulation, or approved equal.

C. NOTE: Ensure that closed-cell spray foam insulation is compatible with spray-applied fireproofing.

D. Spray Insulation at Perimeter of Frames and Penetrations: Provide closed-cell polyurethane foam insulation product to fill gaps, joints, etc. that both seals and insulates, equal to "Great Stuff Professional Foam" as manufactured by the DuPont, or approved equal.

2.6 OPEN-CELL, SPRAY FOAM INSULATION

A. Open-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84, "LD-R-50" as manufactured by Icynene Inc., or comparable product by Carlisle, Thermoseal, approved equal.

1. Minimum density of 0.4 lb/cu. ft., thermal resistivity of 3.4 deg F x h x sq. ft./Btu x in. at 75 deg F.

2. Product shall have passed the Air Barrier Association of America (ABAA) testing and be an approved air barrier product.

B. NOTE: Ensure that closed-cell and open-cell spray foam insulation are compatible with spray-applied fireproofing.

C. Ignition Barrier: Provide a compatible coating tested and certified in accordance with all regulatory requirements.

2.7 SPRAY-APPLIED CELLULOSIC INSULATION

A. Provide "K-13 High-R" applied cellulose insulation made by the International Cellulose Corp., or equal product of another manufacturer meeting standards specified herein.

1. Material shall have a Class 1, Class A flame spread and smoke developed of 0 when tested per ASTM E 84, UL 723 and NFPA-255, and an R value of 6/inch.

2. Provide adhesive as recommended by the manufacturer for application to deck surface prior to application of insulation.

3. Apply insulation to a minimum thickness of 5", unless otherwise noted.

4. Provide intumescent coating DC 315 over insulation.

2.8 ACCESSORIES

A. Clips for Securing Insulation to Encountered Surfaces: Spindle anchor and washer type consisting of perforated metal plates with spindle welded to center and snap-on washers. Spindle and washers shall receive a corrosion-resistant electro-zinc plating. Adhesives for securing clips in place shall be recommended by the approved clip manufacturer.

1. Acceptable Manufacturers

    a. Miracle Adhesives Corp.
    b. Stic-Klip Mfg. Co., Inc.
    c. Midwest Fasteners

B. Adhesive for Bonding Insulation: The type recommended by the insulation manufacturer, and complying with fire-resistance requirements.

1. For bonding rigid polystyrene insulation to masonry or concrete, provide adhesive equal to "Foamgrab PS" made by Dacor Products Co. or equal made by ChemRex Inc. or Miracle Adhesives.

C. Protection Board: Premolded, semi-rigid asphalt/fiber composition board, 1/4" thick, formed under heat and pressure, standard sizes.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where thermal insulation is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION, GENERAL

A. Clean substrates of substances that are harmful to insulation including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

B. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

C. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

D. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 36 inches in from exterior walls.

3.4 INSTALLATION OF SEMI-RIGID MINERAL WOOL INSULATION

A. Install wall insulation with edges closely butted, with joints square, straight and in alignment (no staggered), and with vapor barrier facing on warm side of building, and with exposed faces flush and in the same plane without warp or twist. Cut and fit insulation to closely fit intersecting or penetrating surfaces. Seal joints between insulation, between insulation and intersecting or penetrating surfaces and between insulation and perimeter surfaces with 4" wide vaporproof aluminum tape applied on the vapor barrier side. Insulation shall be friction fit between furring channels or studs.

3.5 INSTALLATION OF BLANKET INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

a. Exterior Walls: Set units with facing placed toward interior of construction as indicated on Drawings.

5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

3.6 INSTALLATION OF SEMI-RIGID INSULATION FOR FRAMED CONSTRUCTION

A. Install wall insulation with edges closely butted, with joints square, straight and in alignment (no staggered), and with vapor barrier facing on warm side of building, and with exposed faces flush and in the same plane without warp or twist. Cut and fit insulation to closely fit intersecting or penetrating surfaces. Seal joints between

insulation, between insulation and intersecting or penetrating surfaces and between insulation and perimeter surfaces with 4" wide vaporproof aluminum tape applied on the vapor barrier side. Insulation shall be friction fit between furring channels or studs.

3.7 INSTALLATION OF SPRAY FOAM INSULATION

A. Apply self-supported, spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make it flush with face of studs by using method recommended by insulation manufacturer.

3.8 INSTALLATION OF SPRAY-APPLIED CELLULOSIC INSULATION

A. Cover other work which might be damaged by fall-out or overspray of materials during spraying operations. Provide temporary enclosure as may be required to confine operations, protect the environment, and ensure ambient conditions and substrate temperature and other conditions as recommended by the manufacturer of the sprayed-on material.

B. Comply with manufacturer's instructions for particular conditions of installation. Consult with manufacturer's technical representative for conditions not covered by printed instructions. Material and water ratio shall be mechanically controlled on site.

1. "K-13 High-R" System

a. Install spray applied insulation according to manufacturer’s recommendations.
b. Install spray applied insulation to achieve an average R-Value of 30.
c. Install approved 6" stick pins 16" o.c. in both directions, starting 3" from the walls.
d. The first pass will be an average of 4" or 5" thick.
e. The color for the first pass will be tan.
f. Install spray applied insulation to manufacturer’s recommendations.
g. Attach Structalath to stick pins with galvanized washers. Pull any slack from lath.
h. Install the second pass of spray-applied insulation to total required R-Value.
i. Color to be Light Gray.
j. Use fans to keep air moving across the material and force moisture laden air outside. The material must be ventilated continuously until dry.
k. Remove and dispose of over-spray.

C. Coat substrate with bonding adhesive where use of adhesive is required or recommended by manufacturer. Apply abrasion resistant coating to all surfaces in accordance with manufacturer’s recommendations.

D. Provide thicknesses as shown on drawings. Extend insulation full thickness over entire area scheduled to receive same. Except as otherwise indicated or recommended by manufacturer, install body of insulation covering material in a single course.

3.9 INSTALLATION OF BOARD INSULATION FOR CONCRETE SUBSTRATES

A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.

3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.

4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.10 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 072700

VAPOR-PERMEABLE AIR BARRIER LIQUID MEMBRANE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the vapor permeable air barrier liquid membrane as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Vapor retarder/air barrier applied over sheathing board and cold formed metal framing, concrete and concrete masonry walls.

2. Materials and installation to bridge and seal the following air leakage pathways and gaps:

a. Connections of the walls to the roof.
b. Connections of the walls to the foundations.
c. Seismic and expansion joints.
d. Openings and penetrations of window frames, storefront, curtain wall.
e. Door frames.
f. Piping, conduit, duct and similar penetrations.
g. Masonry ties, screws, bolts and similar penetrations.
h. All other air leakage pathways in the building envelope.

3. Performance Mockup: Construct assemblies within the mockup for the testing procedure identified in Section 085115 and as shown on architectural drawings and comply with all performance criteria identified herein.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Unit Masonry - Section 042000.

C. Cold-Formed Metal Framing, including sheathing - Section 054000.

1.4 SUBMITTALS

A. Provide evidence to the Architect of licensing and certification under the Air Barrier Association of America's (ABAA's) Quality Assurance Program.

B. Submit shop drawings showing locations and extent of air/vapor barrier and details of all typical conditions, intersections with other envelope systems and materials, membrane counter-flashings, and details showing how gaps in the construction will be

bridged, how inside and outside corners are negotiated and how miscellaneous penetrations such as conduits, pipes electric boxes and the like are sealed.

C. Submit manufacturer's product data sheets for each type of membrane, including manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.

D. Submit manufacturer's data showing solids content of fluid applied membranes and coverage rates and wet film thickness upon application in order to achieve minimum dry film thickness required by this specification.

E. Submit manufacturer's installation instructions.

F. Submit certification by air/vapor barrier manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

G. Submit certification of compatibility by air/vapor barrier manufacturer, listing all materials on the project that it connects to or that come in contact with it, including sealant as specified in Section 054000 for caulking joints between sheathing panels.

H. Submit samples, 3 by 4 inch minimum size, of each air/vapor barrier material required for Project.

I. Test results of air permeability testing of primary air barrier material (ASTM E 2178).

J. Test results of assembly in accordance with ASTM E 2357.

K. Proof that the air barrier is part of an NFPA 285 approved wall assembly.

1.5 PERFORMANCE REQUIREMENTS

A. Provide air/vapor barrier constructed to perform as a continuous air/vapor barrier, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Membrane shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.

B. Provide an air barrier assembly that has been tested in accordance with the Air Barrier Association of America's (ABAA's) approved testing protocol to provide air leakage results not to exceed: 0.04 cfm/sf @ 1.57 psf.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. The air barrier contractor shall be, during the bidding period as well as for the duration of the installation, officially recognized as a Licensed Contractor by the Air Barrier Association of America (ABAA). The contractor shall carry liability insurance and bonding.

2. Each worker who is installing air barriers must be either a Certified Applicator or an installer who is registered with ABAA.

3. Each Lead Certified Applicator can supervise a maximum of five registered installers. The Certified Applicator shall be thoroughly trained and experienced in the installation of air barriers of the types being applied. Lead Certified Applicators shall perform or directly supervise all air/vapor barrier work on the project.

B. Single-Source Responsibility: Obtain air/vapor barrier materials including all accessory materials from a single manufacturer regularly engaged in manufacturing the product.

C. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

D. Field-Constructed Mock-Ups: Prior to installation of air/vapor barrier, apply air/vapor barrier as follows to verify details under shop drawing submittals and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution:

1. Construct typical exterior wall panel, 8 feet long by 8 feet wide (one of CMU and one of sheathed areas, incorporating back-up wall, cladding, window and doorframe and sill, insulation, flashing, building corner condition, and typical penetrations and gaps; illustrating materials interface and seals.

E. Test mock-up in accordance with ASTM E 783 and ASTM E1105 for air and water infiltration.

F. Test mock-up in accordance with ASTM E 783 and ASTM E1105 for air and water infiltration.

G. Manufacturer shall be on-site at least once a week to observe installation and provide written report within 3 days.

H. Manufacturer shall confirm all termination details and compatibility with materials being terminated to.

I. Vertical and Lateral Fire Propagation Test Characteristics: The exterior wall assembly is required to comply with NFPA 285 "Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components." The base wall, stud cavity insulation, wall sheathing, air barrier, continuous wall rigid insulation and exterior cladding are components that are required to be to be evaluated as part of this specific assembly test. The basis of design product listed herein is a component of the design test assembly selected by the Architect.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air/vapor barrier manufacturer. Protect stored materials from direct sunlight.

C. Avoid spillage. Immediately notify Owner, Architect if spillage occurs and start clean up procedures.

D. Clean spills and leave area as it was prior to spill.

1.8 WARRANTY

A. System Warranty: Provide the manufacturer's five (5) year material warranty, including the primary air barrier and installed accessory sealant and membrane materials.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fluid-Applied Membrane: Provide "Air-Bloc 17MR Vapor Permeable Fluid-Applied Membrane" as manufactured by Henry Company, "Perm-A-Barrier VP" as manufactured by GCP Applied Technologies, or a comparable product by W. R. Meadows, or approved equal. Trade names used herein are those of Henry Company.

B. Transition Membrane: Blueskin SA or Blueskin VP 160.

C. Window and Door Opening Flashing: Metal Clad.

D. Liquid Applied Flashing: Henry Air-Bloc LF.

E. Through-Wall Flashing: Blueskin TWF.

F. Primer: Blueskin LVC Adhesive.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where the vapor-permeable air barrier liquid membrane is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected to permit proper installation of the work.

3.2 SURFACE PREPARATION

A. All surfaces must be sound, dry, clean, and free of oil, grease, dirt, excess mortar or other contaminants.

B. Protect adjacent surfaces not designated to receive air barrier.

C. Clean and prepare surfaces to receive air barrier membrane in accordance with manufacturer's instructions.

D. Do not apply membrane to surfaces unacceptable to manufacturer.

E. Concrete surfaces must be clean, free of standing water, ice, snow, frost, dust, dirt, oil, curing compounds or any other foreign material that could prevent proper adhesion of the membrane.

F. Patch all holes and voids and smooth out any surface misalignments.

G. Patch all cracks, protrusions, small voids, offsets, details, irregularities and small deformities with cementitious patching mortar at least two hours before application.

H. Ensure joints between dissimilar building materials are sealed with a strip of self-adhesive membrane 6" wide, centered over the joint.

I. Exterior Sheathing Panels:

1. Install and fasten exterior sheathing panels according to the sheathing manufacturer's instructions.

2. Treat all countersunk and removed fasteners with joint filler or liquid flashing material.

3. Inspect the joint to ensure that all areas to receive joint treatment are clean, dry, smooth, and free from all bond-breaking contaminants.

4. Remove and replace any damaged structural wall components.

5. Joint Treatment using liquid flashing

   a. Fill joint with liquid flashing creating a 1" band over the joint area.
   b. Do not strike flush with the sheathing surface.
   c. Run the spreader tool over the liquid flashing to remove and inconsistencies.

6. Joint Treatment with polyurethane joint sealant

   a. Fill joint with joint sealant and strike flush with the surface of the exterior sheathing panels.
   b. Allow joint sealant to cure for a minimum of 24 hours prior to proceeding with full application of air barrier membrane.

7. Joint Treatment with self-adhesive membrane

   a. Prime either side of the joint extending 3" from the center with adhesive recommended by the manufacturer.
   b. Install a 4" strip of self-adhesive membrane centered over the joint and roll press firmly into place.
   c. Fill all joints wider than 1/4" with detailing membrane prior to application of self-adhesive membrane.

8. Joint Treatment with fluid applied membrane

   a. Fill joint area with fluid applied membrane using a spreader tool or putty knife.
   b. Apply fluid applied membrane extending beyond the joint line 3" onto face of exterior sheathing.
   c. Fully embed the reinforcing fabric 3" wide into the wet fluid applied membrane centered over the joint.
   d. Run the spreader tool or putty knife over the embedded reinforcing fabric to remove any air bubbles.

3.3 APPLICATION OF AIR BARRIER SYSTEM

A. Transition Membrane

1. Prime surfaces to be covered in one working day with applicable primer.

2. Apply transition membrane with a minimum overlap of 3" onto primed surface at all joints, columns, beams, and dissimilar materials.

3. Roll membrane firmly into place.

4. Ensure membrane is fully adhered and remove all wrinkles and fish mouths.

5. Overlap subsequent courses of membrane a minimum of 2" and ensure joints are fully adhered.

6. Seal top edge of transition membrane with pointing mastic.

B. Rough Opening Transition Membrane

1. Self-Adhesive Transition Membrane.

a. Prime the area to be detailed using adhesive recommended by the membrane manufacturer according to the substrate.
b. Pre-cut the self-adhesive membrane for each area of the rough opening to ensure ease of handling.
c. Apply the first pre-cut strip at the base of the rough opening by removing the release paper and rolling firmly into place, ensuring that there is a minimum of 3" of membrane extending onto the wall and a minimum of 3" of membrane extending into the rough opening.
d. Repeat this procedure for the vertical areas of the rough opening and the header portion of the opening.
e. Ensure all edge overlaps are a minimum of 2" and end to end overlaps are 4".
f. Seal all terminations with mastic recommended by membrane manufacturer.

2. Fluid Applied Transition Membrane using vapor permeable membrane

a. Apply a coat of primer on the raw edges of exterior gypsum board.
b. Apply a minimum of 30 wet mil coat of the air barrier membrane extending a minimum of 3" onto the wall.
c. Apply a minimum of 30 wet mil coat of the air barrier membrane extending into the rough opening a minimum of 3".
d. Embed a layer of 6" reinforcing fabric into this first coat.
e. Completely cover the glass mesh with a second coat of the air barrier membrane at 30 wet mils while the first coat is still wet, again extending 3" onto the wall and 3" into the rough opening.
f. Follow this same procedure for concrete or concrete masonry without using the mesh tape ensuring a 60 wet mil thickness is achieved.

3. Fluid Applied Transition Membrane using liquid flashing membrane

a. Apply a coat of primer on the raw edges of exterior gypsum board.
b. Treatment of joints or cracks larger than 1/4" and less than 1/2".

1). Prefill any joints or cracks with the liquid flashing material.
2). Apply a generous bead of material over the joint.
3). Press and spread liquid flashing into the joint.
4). Allow material to skin over prior to full application of liquid flashing into the rough opening.

c. Treatment of joints or cracks larger than 1/2".
1). Install backer rod into the joint to control depth of liquid flashing material.
2). Apply a generous bead of material over and into the joint.
3). Press and spread liquid flashing into the joint.
4). Smooth out using a spreader tool or putty knife.
5). Allow material to cure prior to full application of liquid flashing into the rough opening.

d. Apply a bead of liquid flashing in the rough opening starting at the top and continuing around the rough opening.
e. Spread the material using a spreader tool or putty knife across the rough opening surface.
f. Test the material thickness using a wet mil gauge to ensure that it has a thickness of 12-15 mils.
g. Apply a generous bead of liquid flashing material to the vertical surface around the rough opening and spread this material 4" – 6" onto the vertical surface with a spreader tool or putty knife.
h. Test the thickness to ensure the material has a thickness of 12-15 mils.
i. Allow liquid flashing material to dry before installing any windows, doors, wall assembly, and full air barrier material.

C. Through-Wall Flashing

1. Prime surfaces to be covered in one working day with applicable adhesive.

2. Remove release paper prior to application.

3. Apply though wall flashing at based of masonry walls as indicated on drawings.

4. Recess through wall flashing 1/2" from the face of the masonry.

5. Apply a bead of pointing mastic if through wall flashing is not embedded into masonry.

D. Air Barrier Membrane

1. Apply air barrier membrane in accordance with manufacturer's instructions.

2. Thoroughly mechanically mix membrane prior to application.

3. Apply membrane by spray or roller at a minimum coverage rate of 25 ft^2/U.S. gal providing a thickness of 60 wet mils in two coats.

4. Frequently inspect surface area with a wet mil gauge to ensure consistent thickness.

5. Work material into any fluted rib forming indentations.

6. Cured thickness of membrane should be 30 mils dry.

7. Allow 48 hours for full cure of the membrane.

3.4 PROTECTING AND CLEANING

A. Protect air/vapor barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Protect air/vapor barrier from exposure to the elements as required by the manufacturer.

D. Remove any masking materials after installation. Clean any stains on materials that would be exposed in the completed work using procedures as recommended by manufacturer.

1. Schedule work to ensure that the air and vapor barrier system is covered as soon as possible after installation. Protect air and vapor barrier system from damage during subsequent operations. If the air and vapor barrier system cannot be permanently covered within 30 days after installation, apply temporary UV protection such as dark plastic sheet or tarpaulins.

3.5 FIELD TESTING

A. Contractor shall hire testing laboratory to confirm that the system has been tested and passed requirements in accordance ASTM E 783 and ASTM E 1105 for air and water infiltration. Submit test results to Architect.

END OF SECTION

SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes MCM wall panels.

1.3 DEFINITIONS

A. DBVR: Drained and back-ventilated rainscreen system; rainscreen system designed to drain and dry cavity entering water through drainage channels, weeps, and air ventilation.

B. MCM: MCM; cladding material formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, MCM panel Fabricator and Installer, MCM sheet manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects MCM panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
4. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect MCM panels.
5. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
6. Review temporary protection requirements for MCM panel assembly during and after installation.
7. Review procedures for repair of panels damaged after installation.
8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of MCM panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of MCM panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. MCM Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other MCM panel accessories. Submit custom color samples in paint manufacturer's standard size.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

1. MCM Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance to comparable code sections IBC 1407.14 and IBC 1703.5.
2. MCM System Fabricator's Certified System Tests Reports: Certified system test reports showing system compliance with specific performance or third-party listing documenting compliance code section. Base performance requirements on MCM system type provided.

a. Wet System: Tested to AAMA 501.
b. DBVR System: Tested to AAMA 509.
c. PER System: Tested to AAMA 508.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For MCM panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by MCM Fabricator.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for MCM fabrication and installation.

1. Build mockup of typical MCM panel assembly, including corner, soffits, supports, attachments, and accessories.
2. Water-Spray Test: Conduct water-spray test of mockup of MCM panel assembly, testing for water penetration in accordance with AAMA 501.2.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, MCM panels, and other manufactured items so as not to be damaged or deformed. Package MCM panels for protection during transportation and handling.

B. Unload, store, and erect MCM panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack MCM panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store MCM panels to ensure dryness, with positive slope for drainage of water. Do not store MCM panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on MCM panels during installation.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of MCM panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.11 COORDINATION

A. Coordinate MCM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

A. Warranty on Panel Material: Manufacturer's standard form in which manufacturer agrees to replace MCM that fails within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace MCM panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide MCM panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings
3. Panel Deflection Limit: For wind loads, no greater than 1/60 of the span
4. Framing Member Deflection Limits: For wind loads, no greater than 1/175 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested in accordance with ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration to room side of assembly when tested for 15 minutes in accordance with ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Locate expansion and contraction points to allow for free and noiseless thermal movements from surface temperature changes.

1. Temperature Change (Range): minus 20 deg F to 180 deg F (minus 29 to 82.2 deg C), material surfaces.

E. Fire Propagation Characteristics: MCM wall assembly passes NFPA 285 testing.

2.2 MCM WALL PANELS

A. MCM Wall Panel Systems: Provide factory-formed and -assembled, MCM wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

1. Basis of Design or approved equal

    a. Product: Subject to compliance with requirements, provide ALUCOBOND®; 3A Composites USA Inc.; ALUCOBOND® PLUS or comparable product

B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch- (0.50-mm-) thick, coil-coated aluminum sheet facings.

1. Panel Thickness: 0.157 inch (4 mm).
2. Core: Fire retardant.
3. Exterior Finish: Color anodized

    a. Color: As selected by Architect from manufacturer's full range

4. Peel Strength: 22.5 in-lb/in. (100 N x mm/mm) when tested for bond integrity in accordance with ASTM D1781.
5. Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with ASTM E84.

C. Attachment Assembly Components: Formed from extruded aluminum.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide Fabricator's standard sections as required for support and alignment of MCM panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of MCM panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as MCM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, end walls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent MCM panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide ALUCOBOND®; 3A Composites USA Inc.; ALUCOBOND® Axcent™ Trim or comparable product.

2. Aluminum Trim: Formed with 0.040-inch (1.00-mm-) thick, coil-coated aluminum sheet facings.
3. Color: As selected by Architect from manufacturer's full range

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of MCM panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in MCM panels and remain weathertight; and as recommended in writing by MCM panel manufacturer.

2.4 FABRICATION

A. General: Fabricate and finish MCM panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate MCM panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations or recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations

in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:

1. PVDF Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. FEVE Fluoropolymer: AAMA 2605. One-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
4. Exposed Anodized Finish:

    a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
    b. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by MCM wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by MCM wall panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating MCM panels to verify actual locations of penetrations relative to seam locations of MCM panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and MCM panel manufacturer's written recommendations.

3.3 MCM PANEL INSTALLATION

A. General: Install MCM panels in accordance with Fabricator's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor MCM panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving MCM panels.
2. Flash and seal MCM panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by MCM panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as MCM panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of MCM panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by MCM panel manufacturer.

D. Attachment Assembly, General: Install attachment assembly required to support MCM wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

E. Panel Installation: Attach MCM wall panels to supports at locations, spacings, and with fasteners recommended by Fabricator to achieve performance requirements specified.

1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent MCM wall panels with sealant backing and sealant. Install sealant backing and sealant in accordance with requirements specified in Section 079200 "Joint Sealants."

a. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended in writing by Fabricator. Attach routed-and-returned flanges of wall panels to panel clips with Fabricator's standard fasteners.
b. Panel Installation:

1) Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant in accordance with requirements specified in Section 079200 "Joint Sealants."
2) Seal horizontal and vertical joints between adjacent MCM wall panels with Fabricator's standard gaskets.
3) Joint Sealing: Seal all joints in accordance with AAMA 501.

2. PER Installation: Install using Fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach MCM wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
   a. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by Fabricator. Use Fabricator's standard horizontal tracks and vertical tracks and drain channels that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach MCM wall panels to tracks by interlocking panel edges with Fabricator's standard "T" clips.
   b. Panel Installation:
      1) Attach routed-and-returned flanges of wall panels to perimeter extrusions with Fabricator's standard fasteners.
      2) Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
   c. Joint Sealing: Seal all joints in accordance with AAMA 508. Do not apply sealants to joints unless indicated.
3. DBVR System: Install using Fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by Fabricator. Attach MCM wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
   a. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use Fabricator's standard horizontal tracks and vertical tracks and drain channels that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach MCM wall panels to tracks by interlocking panel edges with Fabricator's standard "T" clips.
   b. Panel Installation:
      1) Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
      2) Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
   c. Joint Sealing: Seal all joints in accordance with AAMA 509. Do not apply sealants to joints unless otherwise indicated.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete MCM panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by MCM panel Fabricator; or, if not indicated, provide types recommended in writing by MCM system Fabricator.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Site Verifications of Conditions:

1. Verify conditions of substrate previously installed under other Sections are acceptable for the MCM system installation. Provide documentation indicating detrimental conditions to the MCM system performance.
2. Once conditions are verified, MCM system installation tolerances are as follows:

a. Shim and align MCM wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Water-Spray Test: After installation, test each installation area of assembly as directed by Architect for water penetration in accordance with AAMA 501.2.

B. Fabricator's Field Service: Engage a factory-authorized service representative to test and inspect completed MCM wall panel installation, including accessories.

C. MCM wall panels will be considered defective if they do not pass test and inspections.

D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as MCM panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of MCM panel installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.

B. After MCM panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace MCM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.23

UNION COLLEGE OF UNION COUNTY

SECTION 07 53 00

EPDM FLEECEBACK THERMOSET SINGLE-PLY ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. EPDM Fleeceback thermoset single-ply roofing.

B. Membrane flashings.

C. Metal flashings.

D. Roof insulation.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 05 31 23 - Steel Roof Decking.

C. Section 06 10 00 - Rough Carpentry.

D. Section 07 62 00 - Sheet Metal Flashing and Trim.

E. Section 07 70 00 - Roof and Wall Specialties and Accessories.

F. Section 08 60 00 - Roof Windows and Skylights.

G. Section 22 30 00 - Plumbing Equipment.

1.3 REFERENCES

A. American Society of Civil Engineers (ASCE) - ASCE 7 - Minimum Design Loads for Buildings and Other Structures, Current Revision.

B. ANSI/SPRI RP-4 "Wind Design Standard For Ballasted Single-ply Roofing Systems".

C. ANSI/SPRI WD-1 "Wind Design Standard for Roofing Assemblies".

D. ASTM International (ASTM):
1. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
2. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
3. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
4. ASTM D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
5. ASTM D 816 - Standard Test Methods for Rubber Cements.

6. ASTM D 4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
7. ASTM D 4637 - Standard Specification for EPDM Sheet Used In Single-Ply Roof Membrane.
8. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

E. Factory Mutual (FM Global):
1. Approval Guide.
   a. Factory Mutual Standard 4470 - Approval Standard for Class 1 Roof Covers.
   b. Loss Prevention Data Sheets 1-28, 1-29.

F. International Code Council (ICC):
1. International Building Code (IBC).

G. National Roofing Contractors Association (NRCA) - Low Slope Roofing and Waterproofing Manual, Current Edition.

H. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.

I. Underwriters Laboratories (UL):
1. TGFU R1306 - "Roofing Systems and Materials Guide".
2. UL-790 - Standard Test Method for Fire Tests of Roof Coverings.

J. ANSI/ASHRAE/IESNA Standard 90.1 (2007): Energy Standard for Buildings Except Low-Rise Residential Buildings

1.4 DESIGN CRITERIA

A. Wind Uplift Performance:
1. Roof system is designed to withstand wind uplift forces as calculated using the current revision of ASCE-7.
2. Roof system is designed to achieve a FM 1-90 wind uplift rating.
3. Roof System is designed to achieve 90-psf of uplift testing.
4. Carlisle 120 MPH wind speed warranty.

B. Fire Resistance Performance:
1. Roof system will achieve a UL Class A rating when tested in accordance with UL-790.

C. Thermal Performance: Roof system will achieve a minimum R value not less than 30.

D. Drainage: Provide a roof system with positive drainage where all standing water dissipates within 48 hours after precipitation ends.

E. Building Codes:
1. Roof system will meet the requirements of all federal, state and local code bodies having jurisdiction.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Detail Drawings:

1. Submit approved plan, section, elevation or isometric drawings which detail the appropriate methods for all flashing conditions found on the project.
2. Coordinate approved drawings with locations found on the Contract Drawings.

D. Selection Samples: For each finish product specified, two complete sets of chips representing manufacturer's full range of available colors, membranes, and thicknesses.

E. Verification Samples: For each finish product specified, two samples, minimum size 4 inches (100 mm) square representing actual product, color, and patterns.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All products specified in this section will be supplied by a single manufacturer with a minimum of twenty (20) years experience.

B. Installer Qualifications:
1. All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.
2. Installer must be capable of extending the Manufacturer's Labor and Materials guarantee.
3. Installer must be capable of extending the Manufacturer's No Dollar Limit guarantee.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Refer to Carlisle's Roofing System specification, Part II - Application, for General Job Site Considerations.

C. Safety Data Sheets (SDS) must be on location at all times during the transportation, storage and application of materials.

D. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.

E. When loading materials onto the roof, the Carlisle Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.

F. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.

G. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.

H. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.

I. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.

J. New roofing shall be complete and weathertight at the end of the work day.

K. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

1.9 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's Total-System warranty, outlining its terms, conditions, and exclusions from coverage.
   1. 30 years NDL Warranty.
   2. Coverage to be extended to include accidental punctures in accordance with terms stated in the Warranty document.
   3. Coverage to be extended to include damage caused by a maximum 2 inch (51 mm) diameter hail in accordance with terms stated in the Warranty document.
   4. Coverage to be extended to include roof edge metal water tightness in accordance with terms stated in the Warranty document.
   5. 40 Year Material Warranty

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Carlisle SynTec Systems, which is located at: P. O. Box 7000; Carlisle, PA 17013; ASD Toll Free Tel: ; 800-4-SYNTEC; Tel: ; 717-245-7000; Fax: ; 717-245-7053; Email:info@carlislesyntec.com; Web:https://www.carlislesyntec.com.

2.2 SCOPE / APPLICATION

A. Roof System: Provide a waterproof roof system, capable of withstanding uplift forces as specified in Design Criteria.

B. Base Flashing: Provide a waterproof, fully adhered base flashing system at all penetrations, plane transitions and terminations.

C. Insulation: Provide a roof insulation system beneath the finish membrane.

2.3 MEMBRANE BASE SHEET

A. VapAir Seal MD Air/Vapor Barrier: reinforced composite aluminum foil with self-adhesive SBS backing and removable poly release film. Used for direct application over metal decks.

2.4 INSULATION

A. Polyisocyanurate InsulBase: Carlisle InsulBase. Rigid board with glass fiber reinforced facers (GRF) on both sides, meeting or exceeding the requirements of ASTM C 1289, Type II, Class 1.
   1. Compressive Strength: Grade 2 (20 psi) (138 kPa).
   2. Density: 2 lb per cubic foot (24 kg/cu m) minimum.

B. SecurShield Polyiso: Rigid board with coated glass fiber mat facers (CGF) on both sides, meeting or exceeding the requirements of ASTM C 1289, Type II, Class 2.
   1. Compressive Strength: Grade 2 (20 psi) (138 kPa).
   2. Density: 2 lb per cubic foot (24 kg/cu m) minimum.

C. Composite Board: Composite insulation panel comprised of 1/2 inch (13 mm) high-density Polyiso cover board laminated during the manufacturing process to SecurShield rigid Polyiso roof insulation meeting ASTM C1289. Carlisle SecurShield HD Composite.
   1. Top Layer: ASTM C1289 Type II, Class 4, Grade 1.
   2. Compressive Strength: 80 psi min. (751 kPa)
   3. Board Thickness: 1/2 inch (13 mm)
   4. Bottom Layer: ASTM C1289 Type II, Class 2
   5. Compressive Strength: Grade 2 (20 psi) (138 kPa).

D. SecurShield HD Plus Polyiso Cover board: Rigid board with coated glass fiber mat facers (CGF) on both sides, meeting or exceeding the requirements of ASTM C 1289, Type II, Class 4, Grade 1. Designed for higher uplift with fewer fasteners per board.
   1. Compressive Strength: 80 psi min. (751 kPa).
   2. Board Thickness: 1/2 inch (13 mm).

2.5 INSULATION ADHESIVE

A. Flexible FAST Adhesive: A spray or extruded applied, two-component polyurethane, low-rise expanding foam adhesive used for attaching approved insulations to compatible substrates (concrete, cellular lightweight insulating concrete, gypsum, cementitious wood fiber, wood or steel) or existing smooth or gravel surfaced BUR, modified bitumen or cap sheets.

B. Flexible FAST Dual Cartridge Adhesive: A two-component, polyurethane construction grade, low-rise expanding adhesive designed for bonding insulation to various substrates using a portable applicator.

C. Flexible FAST Dual Tank Adhesive: A two-component, polyurethane construction grade, low-rise expanding adhesive designed for bonding insulation to various substrates using a portable applicator.

D. Flexible FAST 5 gallon Jug Adhesive: A two-component, polyurethane construction grade, low-rise expanding adhesive designed for bonding insulation to various substrates, packaged for use with spray application rigs.

2.6 ETHYLENE, PROPYLENE, DIENE TERPOLYMER (EPDM) MEMBRANE

A. Sure-Seal FleeceBACK Membrane: Cured, non-reinforced EPDM membrane with a 55 mil fleece bonded to the underside. Meets the requirements of ASTM D 4637 Type I.
   1. Attachment Method: Fully adhered with Flexible FAST.
   2. Color: Black.
   3. Membrane Thickness: 145 mil nominal / 90 mil over fleece.
   4. Sheet Dimensions:
      a. Width: 10 feet (3.04 m) maximum.
      b. Length: 100 feet (30.5 m) maximum.
   5. Performance:
      a. Breaking Strength: 200 lbf (890 N) minimum.
      b. Tear Strength: 45 lbf (200 N) minimum.
      c. Elongation: 480 percent.

2.7 FLASHING ACCESSORIES

A. Sure-Seal (black) Pressure-Sensitive Pipe Seals with Factory-Applied TAPE on the deck

flange are available for use with Sure-Seal Roofing systems.

B. Sure-Seal Pressure-Sensitive Pourable Sealer Pocket: Pre-fabricated Pourable Sealer Pocket consisting of a 2 inch (51 mm) wide plastic support strip with Pressure-Sensitive, Factory-Applied, adhesive backed uncured Elastoform Flashing.

C. Sure-Seal Pressure-Sensitive (PS) Inside/Outside Corner: A 7 inch by 9 inch precut 60-mil thick Elastoform Flashing with a 30-mil Factory-Applied TAPE.

D. Sure-Seal Pressure-Sensitive (PS) Curb Flashing - A 60-mil thick, 20 inch (508 mm) wide cured EPDM membrane with 5 inch (126 mm) wide Factory-Applied Pressure-Sensitive TAPE along one edge to be used to flash curbs/skylights, etc.

E. Sure-Seal Pressure-Sensitive Cured Cover Strip: Sure-Seal 60-mil cured EPDM membrane laminated to a nominal 35-mil cured Factory-Applied TAPE.

F. Sure-Seal Pressure-Sensitive "T" Joint Covers: A factory cut uncured 60-mil thick EPDM flashing laminated to a nominal 35-mil Factory-Applied TAPE, used to overlay field splice intersections and to cover field splices at angle changes. Available in 6 inch by 6 inch and 12 inch by 12 inch for Sure-Seal applications.

G. Sure-Seal Pressure-Sensitive Elastoform Flashing: 60-mil thick uncured EPDM Flashing laminated to a 30-mil Factory-Applied Pressure-Sensitive TAPE used in conjunction with Sure-Seal Primer.

2.8 CLEANERS, PRIMERS, ADHESIVES AND SEALANTS

A. Carlisle Weathered Membrane Cleaner: Clear, solvent-based cleaner used to loosen and remove contaminants from the surface of exposed EPDM membrane prior to applying EPDM Primer.

B. Sure-Seal SecurTAPE: 3 inch (76 mm) or 6 inch (152 mm) wide by 100 foot (30.5 M) long splice tape used for splicing adjoining sections of EPDM membrane.

C. Sure-Seal Lap Sealant: A heavy-bodied material (trowel or gun-consistency) used to seal the exposed edges of a membrane splice.
   1. Sure-Seal Lap Sealant: Black sealant for use with Sure-Seal (black) Roofing Systems.

D. EPDM x-23 Low-VOC Bonding Adhesive: A Low-VOC (volatile organic compound) bonding adhesive (less than 250 grams/liter) used for bonding Sure-Seal/Sure-White EPDM membranes to various surfaces.

E. Low-VOC Bonding Adhesive: A Low-VOC (volatile organic compound) bonding adhesive (less than 250 grams/liter) used for bonding Sure-Seal/Sure-White EPDM membranes to various surfaces.

F. Flexible FAST Adhesive: A spray or extruded applied, two-component, polyurethane, low-rise expanding foam adhesive used to securely bond FleeceBACK membranes to a variety of substrates.

G. Flexible FAST Dual Cartridge Adhesive: A two-component, polyurethane construction grade, low-rise expanding adhesive used to securely bond FleeceBACK membranes to a variety of substrates. The adhesive is extrusion applied 4 inch (102 mm), 6 inch (152 mm) or 12 inch (305 mm) on center (depending on project conditions) using a portable applicator.

H. Flexible FAST Dual Tank Adhesive: A spray applied, two-component, polyurethane construction grade, low-rise expanding adhesive used to securely bond FleeceBACK membranes to a variety of substrates.

I. Flexible FAST 5-gallon Jug Adhesive: A two-component, polyurethane construction grade, low-rise expanding adhesive designed for bonding insulation to various substrates, packaged for use with low pressure urethane equipment.

J. Water Cut-Off Mastic: A one-component, low viscosity, self wetting, Butyl blend mastic used as a compression sealing agent between EPDM membranes and applicable substrates.

K. Sure-Seal One-Part Pourable Sealer: A one-component, moisture curing, elastomeric polyether sealant used as a sealant around hard-to-flash penetrations such as clusters of pipes, and is available in white or black.

L. Universal Single-Ply Sealant: A 100 percent solids, solvent free, one-part, polyether sealant that provides a weather tight sealant to a variety of building substrates; used as a termination bar sealant. Available in white only.

M. CAV-GRIP III Low-VOC Aerosol Contact Adhesive/Primer: a low-VOC, methylene chloride-free adhesive that can be used for a variety of applications including: Priming unexposed asphalt prior to applying Flexible FAST Adhesive, adhering Sure-Seal EPDM, horizontally, for the field of the roof, and for adhering Sure-Seal FleeceBACK and Sure-Seal EPDM membrane to vertical walls. Coverage rate is approximately 2,000-2,500 sq. ft. per 40 lb cylinder and 4,000-5,000 sq. ft. per 85 lb cylinder as a primer, in a single-sided application and 750 sq. ft. per 40 lb cylinder and 1,500 sq. ft. per 85 lb cylinder as an adhesive for vertical walls, in a double-sided application; 1,000 sq. ft. per 40 lb cylinder and 2,000 sq. ft. per 85 lb cylinder as an adhesive, horizontally, for the field of the roof, in a double-sided application.

2.9 FASTENING COMPONENTS

A. HP Fastener: Threaded, black epoxy electro-deposition coated (E-Coat) fastener for use with steel, wood plank or oriented strand board (OSB).

B. InsulFast Fasteners: Threaded, #12 fastener with #3 Phillips head used with 3 inch (76 mm) diameter Insulation Plates. For insulation attachment into steel or wood decks.

C. Pre-Assembled ASAP Fasteners: InsulFast Fastener and pre-assembled 3 inch (76 mm) diameter Plastic Insulation Plate for insulation attachment on adhered and mechanically-fastened roofing systems.

D. Insulation Fastening Plate: Nominal 3 inch (76 mm) diameter FM approved metal plate used for insulation attachment.

E. Sure-Seal Metal Fastening Bar: 1 inch by 10 foot long (25 mm x 3048 mm) Galvalume-coated steel fastening bar pre-punched 6 inches (152 mm) on center for membrane securement on Mechanically Fastened Roofing Systems.

2.10 EDGINGS AND TERMINATIONS

A. SecurEdge 200: A snap-on edge system consisting of a 24 gauge galvanized metal water dam. Finish as noted on the Finish Schedule of the Contract Drawings.

B. SecurEdge 300: A 24 gauge galvanized metal water dam. Finish as noted on the Finish Schedule of the Contract Drawings.

C. SecurEdge 2000: An anchor bar roof edge fascia system consisting of 0.100 inch (2.5 mm) thick extruded aluminum bar, corrosion resistant stainless steel fasteners and snap-on fascia cover.

D. Sure-Seal Drip Edge: A 22 gauge pre-punched 90-degree angle cleat and 12 foot (3658

mm) long fascia sections. Kynar 500 or aluminum finish as noted on the Finish Schedule of the Contract Drawings.

E. SecurEdge 200 Coping: An anchor cleat with pre-slotted holes, a concealed joint cover, and 10 or 12 foot sections of coping cap. Kynar 500 finish as noted on the Finish Schedule of the Contract Drawings.

F. Sure-Seal Termination Bar: 1 inch (13 mm) wide, .098 inch (2.5 mm) thick extruded aluminum bar pre-punched 6 inches (152 mm) on center with sealant ledge to support Lap Sealant.

G. SecurEdge Term Bar Fascia: A 1.75" wide formed aluminum termination bar with pre-slotted fastening holes for ease of locating and installing. The decorative cover is available in 0.040" aluminum or 24-gauge galvanized steel. SecurEdge Term Bar Fascia is manufactured in 12' lengths for fewer joints/seams, fewer sections to handle and faster installation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Do not commence work until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment.

D. A vapor retarder / temporary roof (Carlisle VapAir Seal 725TR Air & Vapor Barrier/Temporary Roof or Carlisle VapAir Seal MD Air & Vapor Barrier) may be applied to protect the inside of the structure prior to the roof system installation.

3.3 INSULATION - SYSTEM DESIGN

A. Base Layer:
1. Type: SecurShield Poly ISO Insulation.
2. Thickness: 3 inches.
3. Attachment Method: Mechanically Fastened.

B. Top Layer:
1. Type: SecurShield HD Composite Poly ISO Insulation.
2. Thickness: 2 inches.
3. Attachment Method: Fully Adhered with Flex Fast Adhesive.

C. Middle Layer - Tapered System:
1. Type: Tapered SecurShield Poly ISO Insulation.
2. Field Slope: 1/4 inch per foot.
3. Sump Slope: 1/2 inch per foot.
4. Cricket Slope: 1/2 inch per foot.
5. Attachment Method: Fully Adhered with Flex Fast Adhesive.

3.4 INSULATION PLACEMENT

A. Install insulation or membrane underlayment in multiple layers over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch (6 mm). Stagger joints both horizontally and vertically.

B. Secure insulation to the substrate with the required mechanical fasteners or insulation adhesive in accordance with the manufacturer's current application guidelines.

C. Do not install wet, damaged or warped insulation boards.

D. Stagger joints in one direction unless joints are to be taped. Install insulation boards snug. Gaps between board joints shall not exceed 1/4 inch (6 mm). Fill all gaps in excess of 1/4 inch (6 mm) with same insulation material.

E. Wood Nailers must be at least 3 1/2 inches (89 mm) wide or 1 inch (25 mm) wider than adjacent metal flange. Thickness must equal that of insulation but not less than 1 inch (25 mm) thickness.

F. Miter and fill the edges of the insulation boards at ridges, valleys and other changes in plane to prevent open joints or irregular surfaces. Avoid breaking or crushing of the insulation at the corners.

G. Do not install any more insulation than will be completely waterproofed each day.

3.5 INSULATION ATTACHMENT

A. Install insulation layers, maximum 4 feet by 4 feet (1220 mm by 1220 mm), applied with adhesive, coverage rate as necessary to achieve the specified attachment and uplift rating. Press each board firmly into place after adhesive develops strings when touched, typically 1-1/2 to 2 minutes after adhesive was applied, and roll with a weighted roller. Add temporary weight and use relief cuts to ensure boards are well adhered. Stagger the joints of additional layers by a minimum of 6 inches (152 mm).

3.6 MEMBRANE PLACEMENT AND ATTACHMENT (FleeceBACK Fully Adhered)

A. Position and unroll successive sheets and align to provide for a minimum 3 inch (76 mm) wide splice.

B. Fold adjacent sheets in half lengthwise to expose an approximate 10 foot (3046 mm) wide substrate area.

C. Membrane which will have the adjacent sheet spliced over it should be adhered to the substrate first. In this fashion, selvage edge splice area will not be contaminated by setting splice edge into the FAST or Flexible FAST Adhesive.

D. Spray or extrude FAST or Flexible FAST Adhesive onto the substrate and allow to foam up approximately 1/8 inch (3 mm). Wait for the adhesive to achieve "string" when a small object is lifted out if the adhesive.

E. Place the membrane into adhesive after adhesive develops strings when touched, typically 1-1/2 to 2 minutes after adhesive was applied, and roll with a 150 lb (68 kg) segmented weighted roller.

F. Apply FAST Adhesive to the substrate and continue process described above until all sheets are fully bonded, allowing for necessary splice overlaps at selvage edges. At end laps (along the width of the sheet) membrane shall be butted together which will be overlaid with 6 inch wide Pressure-Sensitive Cured Cover Strip or Pressure-Sensitive Overlayment Strip.

3.7 MEMBRANE SPLICING (Tape Splice)

A. Overlap adjacent sheets and mark a line 1/2 inch out from the top sheet.

B. Fold the top sheet back and clean the dry splice area (minimum 2 1/2 inches (64 mm wide) of both membrane sheets with Sure-Seal Primer as required by the membrane manufacturer.

C. Where Splice Tape is not Factory-Applied, apply Splice Tape to bottom sheet with the edge of the release film along the marked line. Press tape onto the sheet using hand pressure. Overlap tape roll ends a minimum of 1 inch (13 mm).

D. Remove the release film and press the top sheet onto the tape using hand pressure.

E. Roll the seam toward the splice edge with a 2 inch (51 mm) wide steel roller.

F. Install Pressure-Sensitive "T" Joint Cover, a 6 inch wide (152 mm) section of Pressure-Sensitive Elastoform Flashing over all field splice intersections.

G. When using non-Pressure-Sensitive Elastoform Flashing or Elastoform Flashing, seal edges of flashing with Lap Sealant.

H. The use of Lap Sealant with tape splices is optional except at tape overlaps and cut edges of reinforced membrane where Lap Sealant is required.

3.8 FLASHING

A. Wall and curb flashing shall be cured EPDM membrane. Continue the deck membrane as wall flashing where practicable.

B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

3.9 WALKWAYS

A. Install walkways at all traffic concentration points (such as roof hatches, access doors, rooftop ladders, etc.) and all locations as identified on the Contract Drawings.

B. Adhere walkways pads to the EPDM membrane in accordance with the manufacturer's current application guidelines.

3.10 DAILY SEALS

A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.

B. Use Sure-Seal Pourable Sealer or other acceptable membrane seal in accordance with the manufacturer's requirements.

3.11 CLEAN UP

A. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.

B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-

inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

3.12 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 075323

EPDM MEMBRANE ROOFING AND ROOF INSULATION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the membrane roofing, roof insulation and sheet metal work as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. EPDM sheet membrane roofing, fully adhered.
2. Roof insulation below roof membrane.
3. Sheet flashing.
4. Walkway pads.

1.3 RELATED SECTIONS

A. Steel Deck - Section 053100.

B. Carpentry - Section 062000, for wood blocking.

C. Sheet Metal Flashing - Section 076200.

D. Plumbing - Division 22, for drains and vents.

1.4 DESCRIPTION OF THE SYSTEM

A. The membrane roofing system specified herein shall consist of factory fabricated large sections of sheet membrane fully adhered over the rigid roof insulation. Provide flashing at roof penetrations and vertical surfaces.

1.5 QUALITY ASSURANCES

A. Qualifications

1. The membrane roofing system specified herein shall be the product of a manufacturer who can furnish supporting evidence of experience in the manufacture of the membrane roofing system and of having been regularly engaged in this business for not less than five (5) years. Such experience shall be in projects similar to the requirements and scope for this project.
2. The details and specifications are based on a particular manufacturer. It is not the intention of this specification to restrict competition. If a manufacturer other than

the one specified is selected, it shall be his obligation and responsibility to modify and adjust his materials to suit the encountered conditions and to consult and coordinate his work with other trade Contractors to assure that the installation will be watertight and function for use intended and that the guarantee will be issued to the Owner.

3. Acceptable manufacturers:

   a. Carlisle Syntec Incorporated.
   b. Genflex.
   c. Holcim Elevate.
   d. or an equal acceptable to the Architect.

B. Installer: A firm with not less than 5 years of successful experience in installation of roofing systems similar to those required for this project and which is acceptable to or licensed by the manufacturer of the primary roofing materials.

C. UL Listing: Provide system which has been tested and listed by UL for application indicated and which has a "Class A" rating.

D. The specified roofing assembly must have been successfully tested by a qualified testing agency following ANSI/FM 4474 to resist the design uplift pressures calculated according to American Society of Civil Engineers (ASCE) 7 and after multiplying the results with a safety factor of 3, but assembly uplift pressures shall be not less than 60 lbs./sq. ft.

1.6 SUBMITTALS

A. The samples and certificates listed below are required to be submitted by the Contractor to the Architect, for review. An omission of an item or items does not relieve the Contractor from this responsibility and for compliance with the Contract Documents, of which this is a part.

1. Samples

2.

Item No.	Size	Description
a. S1	6" x 6"	Membrane w/splice
b. S2	6" x 6"	Rigid insulation
c. S3	6" x 6"	Flashing materials

3. Notarized Certificates of Compliance

4.

Item No.	Description	Standard
a. C1	Sheet membrane	As specified
b. C2	Submit manufacturer's published specifications that completely describe the preparation of surfaces and application of roofing systems.	
c. C3	Submit a letter from membrane manufacturer issuing sample guarantee and approving the applicator prior to pre-application conference.	

B. Submit complete shop drawings showing details, dimensions, fabrication and fastening elements for each condition encountered, layout of each sheet noting seam locations, perimeter and penetration flashing, and other details where roofing abuts other materials and/or conditions.

C. Submit copies of pre-roofing conference records.

D. Submit a letter signed by the manufacturer and Contractor acknowledging that the submitted roofing system complies with ASCE-7 and FM I-90 for wind speed code requirements based on height and geographic location of project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site ready for use in the manufacturer's original and unopened containers and packaging, bearing labels as to type and brand. Delivered materials shall match approved samples. Fire classification labels shall be intact and visible.

B. Store materials under cover in a dry and clean location, off the ground and remove materials which are damaged, torn or otherwise not suitable for installation and replace with acceptable materials.

C. Keep insulation and membrane dry before and during installation. Remove wet materials from project site.

D. Store roofing materials on platforms or pallets, above ground, on roof level and cover with tarpaulins or on other suitable watertight covering. Store membrane and handle, in such a way as to prevent damage to edges or ends.

1.8 PREROOFING CONFERENCE

A. Prior to ordering of materials, a preroofing conference will be held to discuss the specified roofing system and its proper application. Conference shall include installer, roofing manufacturer, installers of related work, Architect and representatives of Owner. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours' advance notice to participants prior to convening conference.

B. Coordinate application of the roofing system in such a manner that the complete installation is weather-tight and in accordance with warranty requirements.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Work shall not be installed when the roof deck is damp, wet or spotted with frost or if the ambient temperature is 35 deg. F. and falling or if there is a forecast for inclement weather that may adversely affect the proper installation of the roofing system.

1.10 WARRANTY

A. Provide warranty for the roofing work as specified in this section. Warranty shall state that installed work shall be free from defects of materials and workmanship for twenty (20) years from date of Substantial Completion.

B. Warranty shall be in a form acceptable to the Architect and shall be duly executed by officers or principals of the manufacturer.

C. Contractor shall inform the Architect if conditions exist which will interfere with issuance of the specified warranty. Start of work shall imply that the warranty as specified above will be issued.

D. In addition to manufacturer's warranty, provide roofing Installer's warranty effective for a period of one (1) year from date of Owner's acceptance of the work.

1.11 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Roof: Furnish quantity of full-size units equal to 2% of total amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: The materials provided shall be part of a roofing system developed by the approved manufacturer and shall in every respect be compatible with each other and with the substrates and conditions encountered in the field.

B. Membrane Sheets: 60 mil thick, white, non-reinforced EPDM (Ethylene Propylene Diene Monomer) compounded elastomer, conforming to ASTM D 4637, Type I, Grade 1, Class A.

C. Membrane Flashing: 0.060" thick uncured EPDM; or as recommended by roofing manufacturer.

D. Bonding Adhesives, Mastics and Splicing Cement: Compatible with the materials with which they will come in contact.

E. Lap Sealant: For sealing the exposed edge of the splices and as otherwise required shall be of a consistency recommended by the manufacturer.

F. Prefabricated Pipe Seal Assemblies: Provide assemblies to accommodate vents, pipe penetrations and other similar roof penetrations.

G. Sealers: Provide sealers and other similar accessory materials as recommended by the manufacturer.

H. Cant Strips, Tapered Edge Strips, and Flashing Accessories: Types recommended by membrane manufacturer, including adhesive tapes, flashing cements, and sealants.

I. Membrane Adhesive: As recommended by membrane manufacturer for particular substrate and project conditions, formulated to withstand ASCE 7-02 wind uplift force requirements of the geographic area of the building.

1. Provide adhesives that comply with local requirements limiting amounts of volatile organic compounds.

J. Self-Adhering-Sheet Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40 mil total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer.

K. Roof Insulation: Provide closed-cell polyisocyanurate foam insulation, flat and tapered 1/4" per foot, with black glass reinforced mat laminated to faces, complying with ASTM C 1289 Type II Class 1, 20 psi compressive strength when tested in accordance with ASTM C 1289; with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, and with an average R value (LTTR) of 30.

1. Manufacturer of roofing system must approve use of insulation in writing in advance. Acceptable Product: "ISO 95+ GL" by Holcim Elevate, or approved equal.

L. Cover Board: Provide "Dens-Deck Prime" by Georgia-Pacific Corporation ASTM C 1177, glass-mat, water-resistant gypsum substrate, thickness as indicated on the drawings.

M. Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

1. Weight: 22 lb./sq. ft. unless greater is required to resist wind uplift pressures indicated for the Project.

2. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions, and to resist wind uplift pressures indicated.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where roofing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Nailers

1. Continuous pressure-treated nailers shall be firmly anchored to resist a force of 75 pounds per lineal foot in any direction. The thickness of the nailer shall be such that the top of the nailer is flush with the surface to which the membrane is attached at the horizontal plane.

2. Nailers shall be installed continuous at perimeters and around all roof penetrations unless otherwise noted.

B. Insulation

1. Clean the deck prior to installation of the insulation. Mechanically attach insulation to deck using F.M. approved fasteners in pattern to meet F.M. I-90 minimum and ASCE 7-02 wind uplift requirements, including greater requirements for corners and perimeters as required. For tapered insulation, follow pattern of taper to insure correct pitch.

2. Moderately butt end joints over flutes, stagger joints in adjacent boards. Do not install more insulation in any one day than can be covered by the membrane roof sheets.

3. Where two layers of insulation or cover boards are required, stagger joints two (2) feet in length and width in both directions.

4. Neatly cut around all projections encountered and at abutting vertical surfaces. Where large gaps occur fill with a urethane foam pack.

C. Sheet Membrane Application (Fully Adhered): Where required by manufacturer, install membrane by unrolling over prepared substrate, lapping adjoining sheets. Apply adhesive to surfaces to be bonded and roll into place when adhesive has properly cured. Treat seams with cleaner and prime finish with 4” seam tape and apply sealant to exposed sheet edges, tapering application as recommended by manufacturer. Install mechanical fasteners, flashings and counterflashings, and accessories at locations indicated and as recommended by manufacturer.

D. Splicing

1. Fold the top sheet back about twelve (12) inches and clean both mating surfaces at the splice area using clean rags with membrane manufacturer's recommended cleaner.

2. Apply the inseam tape primer with a synthetic scrub pad at a rate of 375 lineal feet of five (5) inch splice per gallon. Allow tape primer to dry to the touch.

3. Roll the top sheet toward the splice area until the cemented area is nearly touching the cement on the bottom sheet along the entire length of the splice. Allow the top sheet to fall freely into place avoiding stretching and wrinkling. Roll the splice with a two (2) inch wide steel roller, using positive pressure, toward the outer edge of the splice.

4. Solvent clean the splice edge, extending at least one (1) inch onto the top and bottom membranes. Apply a bead of lap sealant completely covering the splice edge, feathering the lap sealant with a preformed putty knife or trowel.

5. Lap sealant application shall be completed on all splices by the end of each working day.

E. Membrane Flashing

1. Perimeter flashing and flashing around vents and other roof penetrations shall be preformed using the recommended flashing, compatible with the approved roofing system and utilizing the longest pieces practicable.

2. The splice between the flashing and the main roof sheet should be completed before bonding the flashing to the vertical surface. Seal this splice at least three (3) inches beyond the fasteners which attach the membrane to the horizontal nailer.

3. Bonding adhesive shall be applied to both the flashing and the surface to which it is being bonded. After the adhesive has dried to the point where it does not string or stick to a dry finger touch, roll the flashing into the adhesive. Take care to assure that the flashing is not bridging where there is any change of direction of the flashing (e.g., where the parapet meets the roof deck).

4. Nail the flashing at the top every 12 inches on center maximum under metal counterflashing or cap. Metal counterflashing is specified under Section 076200.

F. Pipe Flashing

1. Flashing for pipes, conduits and other similar items which are scheduled to penetrate (pass through) the membrane shall be provided with factory prefabricated elements when such use is possible. When prefabricated devices are not possible, field fabricated seals shall be used.

2. Bases of the pipe seals shall be spliced to the membrane roofing sheet as specified above for sheet laps and the top portion shall be secured to the pipe with a stainless steel clamping ring and continuously sealed with sealant in a watertight manner.

3. Field fabricated pipe seals shall be fabricated with base and cap membrane flashing which shall be spliced to the membrane and to itself and continuously sealed with sealant in a watertight manner.

G. Drains: At drain locations, where the insulation is tapered to form a smooth transition from roof surface to membrane, the membrane sheet shall be accurately cut-out so as to fit the encountered clamping ring, and shall be secured to the ring with the addition of the approved mastic in a secure, neat and watertight manner.

H. Curbs, Corners

1. Field fabricated outside corners shall consist of approved membrane flashing which shall have not less than 6" horizontal legs which shall be spliced to the roof membrane, and vertical legs as required which shall be nailed at 12" o.c. maximum. Corners shall be lapped a minimum of 3" and be secured by splicing to each flashing section

2. Field fabricated inside corners shall consist of approved membrane flashing with 6" horizontal legs which shall be spliced to the roof membrane, and vertical legs as required which shall be nailed at 12" o.c. maximum. Corners shall be lapped a minimum 6" and secured by splicing to each flashing section.

3. Install lap type sealant along all seams to insure a watertight installation.

I. Daily Seal: Care should be exercised to ensure that the water does not flow beneath any completed sections of roof. Temporarily seal loose edge of membrane with sealant when weather is threatening.

1. Mix the two components thoroughly according to the instructions on the label.

2. Apply the sealant at a rate of 100 lineal feet per gallon, on smooth surface, 12" back from edge of sheet onto exposed substrate surface. If necessary, use a trowel to spread material in order to achieve complete seal.

3. After embedding membrane in sealant, check for continuous contact. Then weight the edge, providing continuous pressure over the length of the cutoff. The recommended weight for the continuous pressure is a ten (10) foot length of 2-1/2" tubing filled with dry sand.

4. When work is resumed, pull sheet free before continuing installation.

J. Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.3 CLEANING AND PROTECTION

A. From time to time during the progress of the work and at the completion of the work, remove all rubbish, debris, dirt, equipment, and unused materials from the site. Clean adjoining surfaces which may have been soiled by roofing work.

B. Protect installed roofing from damage and abuse by other trades. Repair damages to watertight conditions at no additional cost to the Owner.

C. Exercise care to protect installed work. Work which does become damaged in any way or is not watertight, shall be repaired and/or replaced as directed to the satisfaction of Architect and/or Owner at no additional cost or time.

END OF SECTION

SECTION 076200

SHEET METAL FLASHING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the sheet metal flashing as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Stainless steel cap metal flashing.
2. Stainless steel through-wall flashing.
3. Field fabricating (including bending, cutting, soldering, etc.), if required, of stainless steel flashing.
4. Stainless steel flashing elsewhere, where metal flashing is indicated on drawings.
5. Separation of contacting surfaces of dissimilar metals.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Roofing - Division 7.

1.4 SUBMITTALS

A. Shop Drawings: Submit, showing all materials, finishes, fastenings, joint details, fabrication, construction, and relation to adjoining construction.

B. Samples: Submit 12" x 12" samples of flashing materials and finishes.

1.5 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

1.6 WARRANTY

A. The Contractor shall warrant that all Metal Flashing Work executed under this Section will be free from defects in materials and workmanship for a period of ten (10) years from date of acceptance of the Project, and he shall remedy any defects in the Metal Flashing Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stainless Steel Flashing Materials

1. Stainless Steel Flashing: ASTM A 240, Type 304, stainless steel, with 2D finish, dead soft temper, fully annealed, as manufactured by International Nickel Co., Republic Steel Corp., United States Steel, or Washington Steel Corp. Thickness of stainless steel shall be as listed below.

a. Concealed Flashings: 0.012" thick, thirty (30) gauge (U.S. Standard).
b. Exposed Flashings: 0.015" thick, twenty-eight (28) gauge (U.S. Standard).
c. Edge Strips: 0.025" thick, twenty-four (24) gauge (U.S. Standard).

2. Through-wall flashing shall have sawtooth ribs at three (3) inch intervals, as manufactured by Keystone Flashing Co., or approved equal.

3. Accessories and Fastenings: AISI, Types 302 and 304 stainless steel.

4. Solder: Composed of sixty (60) percent block tin and forty (40) percent pig lead, except that solder at seams exposed to public view shall be eighty (80) percent tin and twenty (20) percent lead.

5. Flux: An acid type flux manufactured specifically for soldering stainless steel, as approved.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where sheet metal flashing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 METAL FLASHING INSTALLATION

A. Reference Standard: Conform to the requirements of 7th Edition of the Sheet Metal and Air Conditioning Contractors Association (SMACNA) Architectural Sheet Metal Manual.

B. General: Fabricate and install metal flashing work in accordance with details and specifications of above Reference Standard, with manufacturer's instructions, and as herein specified, to provide a watertight installation. Apply metal flashing to smooth, even, sound, clean, dry surfaces free from defects. Make provisions to allow for expansion and contraction of metal flashing work. Wherever practicable, shop form all metal flashing work and deliver ready for installation. Form metal flashing work accurately to required profiles, with flat surfaces, straight edges and corners, free from defects. Fold exposed metal edges back not less than 1/2" and form drip.

C. Nailing: Confine to sheets twelve (12) inches or less in width. Confine nailing to one edge only, locate nails where concealed. Use No. 12 x 1" long flat headed, annular threaded, Type 302 stainless steel nails for nailing to wood blocking; use one (1) inch long masonry nails for nailing to concrete. Space nails four (4) inches o.c. maximum.

D. Cleating: Use cleats where sheets are more than twelve (12) inches in width. Space cleats approximately twelve (12) inches o.c. Cleats two (2) inches wide by three (3) inches long, of the same material and weight as the metal flashing being installed. Secure one end of the cleat with two (2) nails and fold edge back over the nail heads. Lock other end into seam or into folded edge of metal flashing sheets. Pre-tin cleats for soldered seams.

E. Joining: Join metal flashings with one (1) inch locked and soldered seams except at slip joints. Mallet seams flat and solder full length of seam as specified below.

F. Soldering: Clean and pre-tin edges of metal flashing to be soldered before soldering is begun with solder on both sides for a width of not less than 1-1/2". Solder slowly with well heated metal surfaces. Use ample solder. Show not less than one full inch of evenly flowed solder on seam. Seams shall have a liberal amount of flux brushed in before soldering is commenced. Where soldering paste or killed acid is employed as a flux, soldering shall follow immediately after application of the flux. Upon completion of soldering, clean surfaces of all flux.

G. Slip Joints: Locate slip joints not more than twenty-four (24) feet apart and not more than eight (8) feet from corners. Form slip joints as three (3) inch wide joints with cover piece behind flashing and fill locked ends neatly with sealant.

H. Cap Flashing: Install over base flashings, in eight (8) to ten (10) foot lengths, lapped six (6) inches at ends. Cap flashing shall be increased longitudinally to produce spring action to hold bottom edge of cap flashing firmly against base flashing. Cap flashing shall lap base flashing at least four (4) inches, with exposed bottom edge at a forty-five (45) degree angle downward and folded back on underside at least 1/2" to form drip. Make cap flashing continuous at corners and angles.

I. Miscellaneous Flashing: Provide all other miscellaneous metal flashing not specifically mentioned herein but indicated on drawings and/or required to provide a watertight installation.

J. Separation of Dissimilar Materials: Back paint surfaces of metal flashing in contact with dissimilar metals or with concrete or masonry with bituminous paint.

K. Reglets

1. Provide watertight reglets in masonry and concrete work to receive cap flashing. Form reglets of stainless steel using same thickness as stainless steel sheet metal specified.

2. In masonry work use open or closed slot reglets with slat at least one (1) inch deep and 3/16" wide. Provide hook dams or turn-ups for anchoring securely into mortar joints. Insert cap flashing into slot full depth using button punch or lead wedges to lock in place.

3. In concrete work, use open or closed slot reglets with slot sloped upward at forty-five (45) degrees, at least one (1) inch deep and 3/16" wide. For fastening reglets to concrete forms use double-head stainless steel nails spaced twelve (12) inches apart maximum.

4. Insert cap flashing full depth into reglet slot, and wedge in place using lead strips spaced on twelve (12) inch centers maximum or lead caulking rope. When lead strips are used for continuous caulked reglets, use approved weather-resistant fibrous compounds.

L. Through-Wall Flashings: Provide through-wall flashings as shown. Form bonding features so as not to puddle water on surface. Lap cross joints to interlock design pattern at least three (3) inches. Stop typical flashings in mortar joint 1/2" from exterior face of wall.

END OF SECTION

SECTION 077100

ROOF SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the roof specialties and accessories as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Roof expansion joints.
2. Aluminum copings.
3. Roof hatches.
4. Prefabricated roof curbs.

1.3 RELATED SECTIONS

A. Roofing - Section 075323.

B. Sheet Metal Flashing - Section 076200.

1.4 SUBMITTALS

A. Shop Drawings: Before any roof specialties and accessories are delivered to the job site, submit shop drawings showing profiles and anchoring devices.

B. Product Certificates: For each type of roof specialty coping and roof-edge flashing that are ANSI/SPRI/FM 4435/ES-1 tested and FM-approved for use based on project requirements.

C. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.

D. Research Reports: For copings and roof-edge flashings, from an agency acceptable to authorities having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

E. Qualification Statements: For manufacturer.

F. Sample warranties.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally-induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install copings, roof-edge specialties that are listed in FM Approvals' "Approval Guide" and approved for windstorm classification, Class as required per roofing specification section. Identify materials with FM Approvals' markings.

C. SPRI Wind Design Standard: Manufacture and install copings, roof-edge specialties tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings, unless ASCE-7 based on location and height is greater.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 ROOF EXPANSION JOINTS

A. Provide neoprene and metal insulated expansion joint assemblies made of 1/16" stainless steel flanges and insulated with 1/2" thick foam insulation. Provide prefabricated units for corners and intersections and provide manufacturer's standard splicing strips and adhesives for installation and splicing of units.

B. Provide "Expand-O-Flash" units made by Manville or equal made by Construction Specialties, Grefco, E-Z Flash, or approved equal.

2.2 ALUMINUM COPINGS

A. Fabricate of 0.063" thick aluminum alloy 5005-H154, smooth, no pattern.

B. Provide concealed splice plates 12'-0" o.c. fabricated of 0.050" thick aluminum to match exposed aluminum; finished to match exposed aluminum.

C. Provide prefabricated mitered and welded corner units.

D. Provide galvanized steel anchor plates, anchors spaced 6'-0" o.c. and snap-lock coping design; all anchors concealed.

E. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

2. Custom color and gloss as selected by the Architect.

F. Provide units manufactured by OMG Roofing, or comparable product by Cheney, Johns Manville, or approved equal.

2.3 ROOF HATCH

A. Provide thermally-broken, shop-primed, galvanized-steel roof hatch units of sizes shown on drawings, with 1" rigid insulation at curbs and door and standard self-lifting mechanism. Provide manufacturer's standard hardware, including hold-open device, hinges, latch and operating handles for inside operation. Construct units for 40 lbs. per sq. ft. live load.

B. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.

1. Height: 42 inches above finished roof deck.

2. Test load per code requirements.

3. Provide self-latching gate fabricated of same materials as safety railing system.

C. Provide units manufactured by Bilco, Babcock-Davis, Milcor or approved equal.

2.4 PREFABRICATED ROOF CURBS

A. Provide manufacturer's standard shop fabricated units made of 14 ga. zinc coated steel factory primed with rust inhibitive primer and insulated with 1-1/2" thick fiberglass board. Provide units manufactured by Pate, Louvers & Dampers, Inc., Industrial Louvers, Inc., or approved equal.

B. Reinforce units over 8'-0" long and units requiring reinforcement due to heavy loads by forming units of double-walled box-type construction with stiffeners of heavy gauge

with flanges as required to provide sufficient rigidity and strength to withstand max. lateral forces in addition to super imposed vertical loads.

C. Sloping Roof Decks: For deck slopes of 1" per ft. and more, fabricate curb units (except expansion joint curbs) to form a level top edge. Where slope is less than 1" per ft., and curb is used to support equipment with moving parts, or supports vertical elements such as gravity ventilators which are intended to be plumb, provide tapered wood nailers (treated wood) at top of curb units to form a level top edge.

D. Provide treated wood nailer, not less than 1-5/8" thick and of the width shown, but not less than the width of the curb wall assembly. Anchor nailer securely to the top of the metal frame unit. Refer to Section 062000 of these specifications for pressure-treatment required for wood nailers.

E. Provide 22 ga. galvanized steel curb liners; where required extend curb liners through deck construction to coordinate with work below.

F. Provide 18 ga. galvanized steel cap flashing to cover a min. of 3" over roof flashing.

G. Where curb units are shown to support shop fabricated items of equipment, do not proceed with fabrication of curb units until size or dimensions have been checked for coordination with equipment.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where roof specialties and accessories are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. General: Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, and with roof insulation, roofing and flashing; as required to ensure that each element of the work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

B. Isolation: Where metal surfaces of units are to be installed in contact with non-compatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

C. Cap Flashing: Where cap flashing is required as component of accessory, install to provide adequate waterproof overlap with roofing or roof flashing (as counter flashing). Seal with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

D. Operational Units: Test operational units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

E. Roof Expansion Joint:

1. Provide uniform profile throughout the length of the installation, and do not stretch the elastic sheet.

2. Nail metal flanges to curbs and cant strips securely as recommended by the manufacturer for waterproof construction.

3. Anchor edges of expansion joint units in the manner indicated, complying with manufacturer's instructions. Provide not less than 4" embedment in bituminous membranes, with hot bitumen or with roofing cement. Cover with composition stripping as specified for the membrane work.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces in accordance with manufacturer's instructions. Touch up damaged metal coatings.

END OF SECTION

SECTION 078100

SPRAYED FIRE-RESISTIVE MATERIALS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the sprayed fire-resistive materials as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Spray-on fireproofing for structural steel and metal decking.
2. Seal coat over fireproofing in special areas.
3. Preparation of surfaces.
4. Field quality control.

1.3 RELATED SECTIONS

A. Structural Steel - Section 051200.

B. Steel Decking - Section 053100.

C. Firestops and Smokeseals - Section 078413.

1.4 SUBMITTALS

A. Product Data: For each fire-resistive product specified.

B. Shop Drawings: Submit structural framing plans indicating the following:

1. Locations and types of surface preparations required before applying sprayed fire-resistive material.
2. Extent of sprayed fire-resistive material for each construction and fire-resistance rating, including the following:
    a. Applicable fire-resistive design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
    b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
3. Identify restrained and unrestrained assemblies on shop drawings, show required thickness of fireproofing for each assembly.

C. Product Certificates: Signed by manufacturer of sprayed fire-resistive material certifying that the products furnished comply with requirements.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. If primer is to be used steel and/or metal deck, submit certifications by supplier of primer that primer is compatible with materials, and will not impair the required performance of the installed fireproofing. Such certification shall be accompanied by evidence that the primer was successfully used in conjunction with the fireproofing material in a UL test applicable to the construction. Submit certification prior to application of primer.

1. Coordinate with Section 051200 "Structural Steel," Section 053100 "Steel Decking," and Structural Drawings prior to application of primer.

G. Product Test Reports: Indicate that physical properties of proposed sprayed fire-resistive materials comply with specified requirements based on comprehensive testing of current product formulations by a qualified testing and inspecting agency according to requirements specified in "Quality Assurance" Article.

H. Code Compliance: Proposed product must comply with the International Building Code/2021, NJ ed., and be approved by those individuals having jurisdiction.

I. Letter from manufacturer stating that the UL Design selected for the project is not load restricted.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its sprayed fire-resistive materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Submit data indicating that products containing no detectable asbestos as determined according to the method specified in 40 CFR, Part 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

C. Mockups: After processing of initial submittals and before delivery and installation of fireproofing materials, prepare a sample installation of fireproofing work, approximately 100 sq. ft. in area; providing an example of each type required, applied on each different substrate, to produce each different rating as required and reasonably representative of entire sprayed on fireproofing work, for joint approval by representative of fire resistant material manufacturer and Owner. Work in other areas shall not proceed until mock-up has been completed. Mock-up work which remains in

compliance with requirements and is in undamaged and acceptable condition may be retained as final work in place.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; shelf life, if applicable; and fire-resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, aboveground, so they are kept dry until ready for use. Remove from Project site and discard materials that have deteriorated.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply sprayed fire-resistive material when ambient or substrate temperatures are 40 deg F. or lower, unless temporary protection and heat is provided to maintain temperatures at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material to achieve a minimum of four air changes per hour. Use natural means or, where this is inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 SEQUENCING

A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosures for interior applications to prevent deterioration of fire-resistive material due to exposure to unfavorable environmental conditions.

2. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.

3. Do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material. Fireproofing shall be considered dry when the moisture content is 6% or less.

4. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.

5. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.

6. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, tested, and corrections have been made to defective applications.

7. Protect permanently exposed walls, floor or special surfaces.

1.9 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty, executed by Contractor and cosigned by Installer, agreeing to repair or replace sprayed fire-resistive materials that fail within the specified warranty period.

1. Failures include, but are not limited to, cracking, flaking, eroding in excess of specified requirements; peeling; and delaminating of sprayed fire-resistive materials from substrates due to defective materials and workmanship within the specified warranty period.

2. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.

C. Warranty Period: Three (3) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For concealed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated in this Article for material composition and physical properties representative of installed products.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

B. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor will not be allowed.

C. Material Composition: Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum or Portland cement binders and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.

D. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property listed as follows:

1. Dry Density: Minimum 15 lb./cu. ft. for average and individual densities regardless of density indicated in referenced fire-resistive design, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI

Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."

2. Thickness: Provide minimum average thickness required for fire-resistive design shown on approved submittals.

   a. Fireproofing shall be of thicknesses and density to meet the requirements of the International Building Code/2021, NJ ed., for type of construction indicated for the project.

3. Bond Strength: Not less than 200 lbf/sq. ft. per ASTM E 736.

4. Compressive Strength: 5.21 lbf/sq. in. as determined in the laboratory per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch and minimum dry density shall be as specified, but not less than 15 lb./cu. ft.

5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.

6. Deflection: No cracking, spalling, delamination, or the like per ASTM E 759.

7. Effect of Impact on Bonding: No cracking, spalling, delamination, or the like per ASTM E 760.

8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch, maximum dry density is 15 lb./cu. Ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.

9. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

   a. Flame Spread: 10 or less.
   b. Smoke Developed: 0.

10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

E. Products: Subject to compliance with requirements, provide products by one of the following:

   1. Cementitious Sprayed Fire-Resistive Material

      a. Type 5GP; SouthWest, Carboline.
      b. Monokote Type MK-6; GCP Applied Technologies.
      c. Cafco 300; Isolatek International Corp., Cafco Products.
      d. Type F3; Promat Firetemp.

2.2 EXPOSED SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For exposed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated for material

composition and for minimum physical properties of each product listed, measured by standard test methods referenced with each property.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

B. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor will not be allowed.

C. Cementitious Sprayed Fire-Resistive Material: Factory-mixed, dry, cement aggregate formulation, chloride-free formulation of Portland cement binders, additives, and inorganic aggregates, mixed with water at Project site to form a slurry or mortar for conveyance and application, complying with the following requirements:

1. Dry Density: Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination," but with an average density of not less than 22 lb./cu. ft.

2. Bond Strength: 2000 psf minimum per ASTM E 736.

3. Compressive Strength: 100 psi per ASTM E 761.

4. Corrosion Resistance: No evidence of corrosion per ASTM E 937.

5. Deflection: No cracking, spalling, delamination, or the like per ASTM E 759.

6. Effect of Impact on Bonding: No cracking, spalling, delamination, or the like per ASTM E 760.

7. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. per ASTM E 859.

8. Combustion Characteristics: Passes ASTM E 136.

9. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

    a. Flame Spread: 10 or less.
    b. Smoke Developed: 0.

10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

11. For exterior applications of sprayed fire-resistive material, provide manufacturer's formulation approved for surfaces exposed to the exterior.

D. Products: Subject to compliance with requirements, provide one of the following:

1. Cement-Aggregate Cementitious Sprayed Fire-Resistive Material:

    a. Pyrocrete 239; Carboline Co., Fireproofing Products Div.
    b. Monokote Type Z106HY; GCP Applied Technologies.

c. F4; Promat Firetemp.
d. Cafco 400, Isolatek International Corp; Cafco Products.

2.3 AUXILIARY FIRE-RESISTIVE MATERIALS

A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistive designs indicated.

B. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material, used where required by manufacturer to insure proper bond.

C. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistive designs indicated and fire-resistive product manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

D. Sealer for Sprayed Fire-Resistive Material in Elevator Shafts and Open Area Plenums: Transparent-drying, water-dispersible protective coating by manufacturer of fire-resistive material.

1. Product: Subject to compliance with requirements, provide "Firebond Concentrate" by GCP Applied Technologies, or similar product recommended by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, to determine whether they are in satisfactory condition to receive sprayed fire-resistive material. A substrate is in satisfactory condition if it complies with the following:

1. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive material with substrate under conditions of normal use or fire exposure.

2. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.

3. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.

B. Do not proceed with installation of fire-resistive material until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances that could impair bond of fire-resistive material, including oil, grease, rolling compounds, incompatible primers, and loose mill scale.

B. For exposed applications, repair substrates to remove any surface imperfections that could affect uniformity of texture and thickness in finished surface of sprayed fire-resistive material. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

C. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application. Provide temporary enclosure as required to confine spraying operations, protect the environment, and ensure maintenance of adequate ambient conditions for temperature and ventilation.

3.3 INSTALLATION

A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to convey and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Install metal lath, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by fire-resistive material manufacturer. Attach lathing accessories where indicated or required for secure attachment to substrate.

C. Coat substrates with adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by fire-resistive material manufacturer for material and application indicated.

D. Extend fire-resistive material in full thickness over entire area of each substrate to be protected.

E. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by method recommended by the manufacturer.

F. Where sealers are used, apply products that are tinted to differentiate them from the sprayed fire-resistive material over which they are applied.

G. Maintain ambient conditions during installation and for cure period following installation, as recommended by manufacturer. Provide ventilation and avoid excessive rate of drying.

H. Fireproofing to the underside of roof deck assemblies shall be done only after roofing application is complete, all roof mounted mechanical equipment is in place, and the roof is watertight.

I. No fireproofing shall be applied prior to completion of concrete work on steel decking.

J. Installation Sequence of Fireproofing: All patching and repairing of sprayed fireproofing, due to cutting by other trades or testing and inspection, shall be performed under this Section.

K. Provisions shall be made for ventilation to properly dry the fireproofing after application. In enclosed areas lacking natural ventilation, air circulation and ventilation must be provided.

3.4 FIELD QUALITY CONTROL (FREQUENCY PER BELOW UNLESS MORE STRINGENT PER BUILDING CODE)

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing and inspecting of completed applications of sprayed fire-resistive material will take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of fire-resistive material for the next area until test results for previously completed applications of fire-resistive material show compliance with requirements.

1. For each 1000-sq. ft. area, or partial area, on each floor, testing and inspecting agency will evaluate the following characteristics. Tested values must equal or exceed values indicated and values required for approved fire-resistance design.

a. Thickness for Floors, Roofs, and Walls: From the average of 10 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.

2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.

3. For each 10,000 sq. ft. area, or partial area, on each floor, testing and inspection agency will evaluate the following characteristics. Tested values must equal or exceed values indicated and values required for approved fire resistance design.

a. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: Cohesion and adhesion at frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 736.

4. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."

5. When testing discovers applications of fire-resistive material not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.

C. Remove and replace applications of fire-resistive material where test results indicate that they do not comply with specified requirements for cohesion and adhesion or for density, or both.

D. Apply additional fire-resistive material per manufacturer's written instructions where test results indicate that thickness does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING, PROTECTING, AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Cure exposed sprayed fire-resistive material according to product manufacturer's written recommendations to prevent premature drying.

C. Protect fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at the time of Substantial Completion.

D. Coordinate application of fire-resistive material with other construction to minimize the need to cut or remove fire protection. As installation of other construction proceeds, inspect fire-resistive material and patch any damaged or removed areas.

1. Patch and repair fireproofing where Owner’s Testing Agency has performed tests.

E. Repair or replace work that has not been successfully protected.

END OF SECTION

SECTION 078123

INTUMESCENT FIREPROOFING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the intumescent fireproofing as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Intumescent fireproofing for exterior application.

2. Intumescent fireproofing for interior application.

1.3 RELATED SECTIONS

A. Structural Steel - Section 051200.

B. Painting and Finishing - Section 099000.

1.4 REFERENCES

A. ASTM Test Standards

1. ASTM D 2240 – Durometer Hardness (Shore D Only).

2. ASTM D 2794 – Impact Resistance.

3. ASTM D 4060 – Abrasion Resistance.

4. ASTM D 4541 – Bond Strength.

5. ASTM E 84 – Surface Burning Characteristics of Building Materials.

6. ASTM E 119 – Fire Tests of Building Construction and Materials.

B. The Society of Protective Coatings (SSPC):

1. SSPC SP-6: Commercial Blast Cleaning Standard.

C. Underwriters' Laboratories Inc. (UL):

1. Fire Resistive Directory, Volume 1; Current edition. Classification identified as Mastic and Intumescent Coatings (CDWZ)

2. UL 263 - Fire Test of Building Construction and Material

1.5 QUALITY ASSURANCE

A. Material Manufacturer: Company specializing in manufacturing products listed in this section.

1. Fire Protection Factory Manufacturer: Company specializing in manufacturing the work of this section with a minimum of three years' documented experience and certified by the material manufacturer.

B. Fire Protection Installer: Company specializing in installing the work of this section with a minimum of three years' documented experience and certified by the material manufacturer.

C. Product

1. All products listed in this section must be manufactured under the appropriate follow-up service with each container bearing the certified label (mark).

2. Intumescent fireproofing shall be a complete system consisting of compatible primer, intumescent fireproofing coating, adhesive, edge sealant and decorative topcoat.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Before proceeding with the work, the installer will apply the primer, intumescent fireproofing, and decorative top coat to a representative substrate section of 10 square feet in size. Areas will be designated by the Architect.

2. Materials must be applied in accordance with the project requirements for fire rating thickness, finish texture and color.

3. The application must be witnessed by the Architect's or Owner's representative and is subject to their approval. Once agreed upon in writing, it serves as a guide for the finished work.

4. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

5. Refinish mock-up area as required to produce acceptable work.

1.6 SUBMITTALS

A. Product Data: Submit product data including manufacturer's technical information indicating product performance characteristics, performance and limitation criteria for each product specified herein.

B. Submit evidence indicating that manufacturer of the intumescent fireproofing coating has reviewed and approved shop primer to be used by the structural steel fabricator; refer to Section 051200, "Structural Steel," for primer description.

C. Submit evidence indication that manufacturer of the intumescent fireproofing coating has reviewed and approved proposed topcoat.

D. Fire Test Evidence: Submit published third-party design listings for fire resistance ratings and product thickness. Include evidence that the fire testing was sponsored by the manufacturer and that the material tested was produced at the manufacturer's facility under the supervision of third-party certification personnel.

E. Installation Instructions: Submit manufacturer's written installation instructions.

F. Installer Qualifications: Submit applicator's current certification as a manufacturer trained and approved installer.

G. Shop Drawings: Submit plan, section, elevation, and perspective drawings as necessary to depict system configuration, design considerations and application procedures.

H. Selection Samples: For each finish product specified, submit samples representing manufacturer's range of available materials, finishes and shapes.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in manufacturer's original, sealed, undamaged container with identification label intact. Packaged materials must bear the appropriate labels, seals and designated certification mark for fire resistive ratings.

B. Storage: Store materials in strict accordance with manufacturers documented instructions.

C. Documentation: All batch number, product identification and quantities shall be recorded on appropriate QC documents. A copy of the transport document and manufacturers conformance certificate shall be attached to the material delivery QC form.

D. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Project Environmental Requirements: Substrate and air temperature shall be in accordance with the manufacturer's requirements.

1. Protect work area from windblown dust and rain. Protect adjacent areas from over spray of fireproofing material.

2. Provide ventilation in areas to receive work of this section during application and minimum 24 hours after application.

B. Temperature and Humidity Requirements: Maintain air temperature and relative humidity in areas where products will be applied for a time period before during and after application as recommended by manufacturer.

1. Do not install intumescent fire protection system when temperature of substrate and/or surrounding ambient air temperature is below 41 degrees F. Temporary protection and heat shall be maintained at this minimum temperature for 24 hours before, during and 24 hours after material application.

2. Steel substrate temperature shall be a minimum of 5 deg F. above the dew point of the surrounding air for a period of 24 hours prior and during the application of the material.

3. If necessary for job schedule, the Contractor shall provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.

4. The relative humidity of the application area shall not exceed a maximum of 85 percent for 24 hours prior, during and 24 hours after the application of the material.

1.9 SEQUENCING AND SCHEDULING

A. Sequence and coordinate installation of fireproofing system with Work in other sections which would interfere with efficient fireproofing application.

B. Do not apply fire protection materials to supporting structural steel until the concrete toppings and/or roofing applications have been completed and are substantially dry.

1.10 WARRANTY

A. At project closeout, provide to Owner an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

1. Duration: Minimum two years.

PART 2 PRODUCTS

2.1 INTUMESCENT FIREPROOFING COATING FOR EXTERIOR APPLICATION

A. Acceptable Products

1. "CFP-SPWB Fire Finish" made by Hilti.

2. "Interchar 212" made by International Paint.

3. "Thermo-Lag 3000SP" made by Carboline.

4. "Albi Clad 800" made by Albi Mfg. Co.

5. "Cafco Spray Film WB-4" with "Topseal" topcoat made by Isolatek International.

6. Other manufacturers may submit their equivalent products for approval by the Architect provided they meet physical properties noted herein.

B. Description: A high performance, intumescent fireproofing coating designed to be used on exterior steelwork requiring protection from fires.

1. Compliance: Intumescent coating must meet the following minimum physical requirements:

a. Recognized by FM Approvals as a Specification Tested Product in accordance with ASTM E 119.

b. Tested in accordance with UL 263 (exterior listed) and UL 1709 (Design XR627).
c. Tensile Strength, ASTM D 638: Min. 1640 psi.
d. Compressive Strength, ASTM D 695: Min. 1500 psi.
e. Flexural Strength, ASTM D 790: Min. 1400 psi.
f. Durometer Hardness, ASTM D 2240: Min. 60 Shore D.
g. Surface Burning Characteristics, ASTM E 84: Class A rating.

2. Application: Site-applied coatings.

C. Fireproofing Performance: Provide intumescent fireproofing, tested by independent testing agency in accordance with ASTM E 119/UL 263, and acceptable to authorities having jurisdiction:

1. Listed by UL and bearing the UL label.

D. Structural Steel Fire Resistance Rating: Refer to the drawings.

E. Accessory Materials: Manufacturer's recommended adhesive and edge sealant.

F. Shop Primer Coating: Refer to Section 051200, "Structural Steel."

G. Decorative Topcoat: Approved by the intumescent fireproofing material manufacturer and applied in accordance with the topcoat manufacturer's documented instructions, custom colors as selected by the Architect.

2.2 INTUMESCENT FIREPROOF COATING FOR INTERIOR APPLICATION

A. Acceptable Products

1. "CFP-SPWB Fire Finish" made by Hilti.

2. "Interchar 1120" made by International Paint.

3. "Thermo-Lag Series" made by Carboline.

4. "Albi Clad TF" made by Albi Mfg. Co.

5. "Cafco Spray Film – WB 5" made by Isolatek International.

B. Description: A single pack, chlorine-free, water borne intumescent coating site applied over shop applied prime coat (see Section 051200). Coating must meet the following minimum physical requirements.

PROPERTY	TEST METHOD	VALUE
Dry Applied Density		85 PCF
Hardness	ASTM D 2440	60
Compressive Strength	ASTM D 695	500 psi
Bond Strength	ASTM D 4541	145 psi
Abrasion Resistance	ASTM D 4060	0.16 grams loss @1000 Cycles
Flame Spread	ASTM E 84	Class A
Smoke Developed	ASTM E 84	Class A

C. Fireproofing Performance: Provide intumescent fireproofing system, tested by independent testing agency in accordance with ASTM E 119/UL 263, and acceptable to authorities having jurisdiction:

1. Listed by UL and bearing the UL label.

D. Structural Steel Fire Resistance Rating

1. Fire Resistance Rating: 2 hours.

2. UL Design Number: As required to achieve 2 hour rating.

E. Accessory Materials: Manufacturer's recommended adhesive and edge sealant.

F. Shop Primer Coating: Refer to Section 051200, "Structural Steel."

G. Decorative Topcoat: Approved by the intumescent fireproofing manufacturer and applied in accordance with the topcoat manufacturer's documented instructions, custom colors as selected by the Architect.

PART 3 EXECUTION

3.1 EXAMINATION

A. All surfaces to receive the fire protection material must be clean, dry and free of oil, grease, loose mill scale, loose shop primer, dirt, dust or other foreign substances which would impair bond of the fire protection material to the substrate.

B. Do not commence installation of the fire protection system until the contractor, installer and fire protection manufacturer’s representative have examined the surfaces to receive the fire protection and determined the surfaces are acceptable to receive the fire protection material. Commencement of installation is acceptance of substrate.

C. Verify that substrate and workspace temperature and humidity conditions are in accordance with requirements of this section.

D. Verify that all clip hangers, piping, ducts, equipment, or other items which would interfere with the installation of the factory-manufactured architectural fire protection system are not positioned or installed until installation is complete.

3.2 PREPARATION

A. Provide masking, drop cloths or other suitable coverings to prevent overspray onto surfaces not intended to be affected by Work in this section.

B. Clean substrate free of dust, dirt, grease, or other foreign substances that would impair with the bond of the intumescent fireproofing protection adhesive material.

C. Grind smooth all weld spatter and defects prior to commencement of fire protection installation and touch-up shop primer in the field using same paint as shop primer.

3.3 APPLICATION (FIELD APPLIED)

A. Equipment and installation procedures must conform to the manufacturer's installation instructions. The intumescent fireproofing protection material shall be applied at the required dry film thickness to achieve fire resistance rating specified herein.

B. Install fire protection material only to primed surfaces and in accordance with manufacturer's installation instructions. Refer to Section 051200 for steel shop primer.

C. Final texture and finish of the intumescent fireproofing must be completed prior to the application of the decorative top coat and in accordance with the Architect’s approval and approved mock-up samples. Finish shall be level 4 (high end architectural – spray applied, back rolled and sanded smooth).

D. Apply decorative top coat in accordance with the manufacturer's application instructions. Final color, gloss and finish will be determined and approved by the Architect.

3.4 FIELD QUALITY CONTROL

A. The Owner shall retain the services of an independent testing laboratory to inspect and verify the installation of the intumescent fireproofing material in accordance with the provisions of AWCI Technical Manual 12-B, Standard Practice for the Testing and Inspection of Field Applied Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide.

B. The fire protection material inspection must be performed prior to the application of the decorative top coat.

C. All test results must be made available to all parties at the completion of each pre-designated area and approved prior to the application of top coat.

D. Intumescent fireproofing not in compliance with the specification requirements must be corrected prior to the application of the decorative top coat.

3.5 CLEAN UP AND REPAIR

A. Upon completion of installation, all excess material, overspray and debris must be cleared and removed from the job site.

B. Remove fire protection materials from surfaces not required to be fireproofed.

C. All patching and repair to intumescent fireproofing, due to damage by other trades, shall be performed under this section of work. Patching must be performed by the installer of the intumescent fireproofing and applied in accordance with the manufacturer's installation instructions.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 078413

FIRESTOPS AND SMOKESEALS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the firestops and smokeseals as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Penetrations through fire-resistance-rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.

4. Sealant joints in fire-resistance-rated construction.

5. Penetrations at each floor level in shafts and/or stairwells.

6. Construction joints, including those between top of fire rated walls and underside of floors above; and those between exterior curtain walls and the outer perimeter edge of floor assemblies.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Unit Masonry - Section 042000.

C. Joint Sealants - Section 079200.

D. Aluminum Entrances and Storefronts - Section 084113.

E. Gypsum Drywall - Section 092900.

F. Piping penetrations - Division 22.

G. Duct penetrations - Division 23.

H. Cable and conduit penetrations - Division 26.

1.4 REFERENCES

A. ASTM E 814 "Standard Method of Fire Tests of Through-Penetration Firestops."

B. UL 1479, UBC 7-5 (Both are same as A. above).

C. ASTM E 136 "Standard Test Method for Assessing Combustibility of Materials."

D. UL 263, UBC 7-1 "Fire Tests of Building Construction and Materials"

E. UL 2079 "Tests for Fire Resistance of Building Joint Systems."

F. ASTM E 1399 "Test for Dynamic Movement Conditions."

G. ASTM E 1966 (Same as E. above).

H. ASTM G 21 "Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi."

I. ASTM E 1725 "Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components"

J. UL 1489 "Fire Tests of Fire-Resistant Pipe Protection Systems Carrying Combustible Liquids"

K. Test Requirements: ASTM E 2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus."

L. Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Firestops."

M. Published Through-Penetration Systems by recognized independent testing agencies.

1. UL Fire Resistance Directory, Volume II of current year.

2. Warnock Hersey Certification Listings, current year.

3. Omega Point Laboratories, current year.

N. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.

O. NFPA 101 – Life Safety Code.

P. NFPA 70 – National Electric Code.

Q. NFPA 72 – National Fire Alarm and Signaling Code.

1.5 SUBMITTALS

A. Submit manufacturer's product literature for each type of firestop material to be installed. Literature shall indicate product characteristics, typical uses, performance,

limitation criteria, test data and indication that products comply with specified requirements.

B. Submit shop drawings detailing materials, installation methods, and relationships to adjoining construction for each firestop system, and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspection agency evidencing compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, for proposed UL listed (or equal) firestop and smokeseal assembly required for the Project.

C. Material Safety Data Sheets: Submit MSDS for each firestop product.

D. Submit qualifications of firestop installer, including letter from firestop manufacturer of products proposed to be installed, wherein manufacturer approves or recognizes as trained/ or certifies installer for installation of that manufacturer's products.

E. Engineering Judgment: For those firestop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents must follow requirements set forth by the International Firestop Council.

1.6 QUALITY ASSURANCE

A. General: Provide firestopping systems that are produced and installed to resist the spread of fire and the passage of smoke and other gases.

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.

1. Installer Qualifications (one of the following):

a. A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors."
b. A firm that has been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
c. A manufacturer’s Accredited Firestop Specialty Contractor (see Part 2.0 for list of acceptable manufacturers).
d. A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this project, whose work has resulted in construction of a minimum of five projects with a record of successful performance.

C. Single Manufacturer Sourcing: Source all firestop products and required accessories from a single manufacturer. See Part 2.0 for list of acceptable manufacturers.

D. Firestopping materials shall conform to Flame (F) and Temperature (T) ratings as required by local building code and as tested by nationally accepted test agencies per ASTM E 814 or UL 1479. The F-rating must be a minimum of one (1) hour, but not

less than the fire resistance rating of the assembly being penetrated. T-rating, when required by code authority, shall be based on measurement of the temperature rise on the penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.

1. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

    a. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
    b. T-Rating: When penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
        1). T-ratings shall be achieved by utilizing a Low Bio Persistent Endothermic Mat incorporating foil scrim on both sides.
    c. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

2. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

    a. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.

E. Firestopping products shall be asbestos free and free of any PCBs.

F. Do not use any product containing solvents or that requires hazardous waste disposal.

G. Do not use firestop products which after curing, dissolve in water.

H. Do not use firestop products that contain ceramic fibers.

I. Mock-Up: Prepare job site mock-ups of each typical Firestop System proposed for use in the project. Approved mock-ups will be left in place as part of the finished project and will constitute the quality standard for the remaining work.

J. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

K. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of less than or equal to 1 as determined by ASTM G 21.

L. Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post-installed." Provide cast-in-place firestop devices prior to concrete placement.

M. Firestop systems do not reestablish the structural integrity of load bearing partitions or assemblies, or support live loads and traffic. Installer shall consult the Structural Engineer prior to penetrating any load bearing assembly.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened containers with manufacturer's name, product identification, lot numbers, UL or Warnock Hersey labels, and mixing and installation instructions, as applicable.

B. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturer.

C. All firestop materials shall be installed prior to expiration of shelf life.

1.8 PROJECT CONDITIONS

A. Verify existing conditions and substrates before starting work.

B. Do not use materials that contain solvents, show sign of damage or are beyond their shelf life.

C. During installation, provide masking and drop cloths as needed to prevent firestopping products from contaminating any adjacent surfaces.

D. Conform to ventilation requirements if required by manufacturer's installation instructions or Material Safety Data Sheet.

E. Weather Conditions: Do not proceed with installation of firestop products when temperatures are in excess or below the manufacturer's recommendations.

F. Schedule installation of firestop products after completion of penetrating item installation but prior to covering or concealing of openings.

G. Coordinate this work as required with work of other trades.

1.9 SEQUENCING AND SCHEDULING

A. Firestop and Life Safety Design: Obtain all required tested firestop systems before installation and document on shop drawings. Where possible, identify all conditions where tested firestop systems will not meet Project conditions. Obtain Engineering Judgements (EJs) for these conditions from firestop manufacturer and confirm advance approval from Authorities Having Jurisdiction (AHJs).

B. Pre-Installation Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Invite all applicable parties including installers, general contractors, and firestop manufacturer’s representative to conference.

C. Sequence: Perform work of this and other sections in proper sequence to prevent damage to the firestop systems and to ensure that their installation will occur prior to enclosing or concealing work.

D. Install all firestop systems after voids and joints are prepared sufficiently to accept the applicable firestop system.

E. Do not cover firestop systems until they have been properly inspected and accepted by the authority having jurisdiction.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following manufacturers or approved equal:

1. Basis-of-Design: Hilti, Inc.

2. Firestop systems and products from manufacturers listed below shall be considered in accordance with contract provisions and performance requirements listed in this document:

a. Specified Technologies Inc.
b. 3M; Fire Protection Products Division.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.

B. Accessories: Provide components for each firestopping system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:

1. Permanent forming/damming/backing materials including the following:

a. Semi-refractory fiber (mineral wool) insulation.
b. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Joint fillers for joint sealants.

2. Temporary forming materials.

3. Substrate primers.

4. Collars.

5. Steel sleeves.

C. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

D. Smokeseals at top of partitions shall be flexible to allow for partition deflection.

E. Polypropylene Sleeves (PP): (For cast-in device options.)

2.3 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS

A. Intumescent, Latex Sealant: Single-component, Intumescent, latex formulation.

1. Basis of Design: Hilti Intumescent Firestop Sealant (FS-ONE MAX).

B. Intumescent Putty: Non-hardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.

1. Basis of Design: Hilti Firestop Putty Stick (CP 618).

C. Intumescent Wrap Strips: Single-component, elastomeric sheet with aluminum or polyethylene foil on one side.

1. Basis of Design: Hilti Firestop Wrap Strips (CP 648).

D. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.

1. Basis of Design: Hilti Firestop Mortar (CP 637).

E. Pillows/Bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.

F. Moldable Putty Pads

1. Basis of Design: Hilti Firestop Putty Pad (CP 617).

G. Silicone Foam: Two-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, non-shrinking foam.

H. Silicone Foam: Two-component, polyurethane foam thatexpands and cures in place to produce a flexible, non-shrinking foam.

1. Basis of Design: Hilti Firestop Foam (CP 660).

I. Silicone Sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and non-sag formulation for openings in vertical and other surfaces requiring a non-slumping/gunnable sealant, unless firestop system limits use to non-sag grade for both opening conditions.

2. Basis of Design: Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).

J. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic or polypropylene sleeve lined with

an intumescent strip, an extended rectangular flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

1. Basis of Design: Hilti Cast-in Firestop Sleeve (CP 680).

K. Low Voltage Cable Management Devices: Factory-assembled round or rectangular metallic sleeve device for use with cable penetrations. Round devices shall contain an integrated smoke seal fabric membrane that can be opened and closed for re-penetration. Rectangular devices shall be modular to accommodate future use.

1. Basis of Design: Hilti Firestop Modular Sleeve System or Firestop Speed Sleeve (CFS-MSL or CP 653, respectively).

L. Drop-In Firestop Devices: Factory-assembled devices for use with combustible or noncombustible penetrants in cored holes within concrete floors. Device shall consist of galvanized steel sleeve lined with an intumescent strip, an extended rectangular flange attached to one end of the sleeve for fastening to concrete floor, and neoprene gasket.

1. Basis of Design: Hilti Drop-In Device (CFS-DID).

M. Firestop Collars: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

1. Basis of Design: Hilti Firestop Collar (CP643).

N. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

1. Basis of Design: Hilti Firestop Composite Sheet (CFS-COS).

O. Blocks/Plugs: Non-curing, re-penetrable intumescent materials used for large size/complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways.

1. Basis of Design: Hilti Firestop Block (CFS-BL).

P. Tub Box Kit: Cast-in place pre-formed plastic tub box kit with three support legs for use with drain piping assembly associated with bathtub installations.

1. Basis of Design: Hilti Tub Box Kit (CP 681).

Q. Endothermic Mats: Low Bio Persistent Endothermic Mat incorporating foil scrim on both sides. Mat evaluated for protection of cable pathways and liquid fuel lines, for firestopping of through-penetrations and membrane-penetrations, and for achieving T-ratings

1. Basis of Design: Hilti Endo-Shield (CFP-ES).

2.4 FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated that complies with ASTM C 920

requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.

1. Sealant Colors: Color of exposed joint sealants as selected by the Architect.

B. Single-Component, Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, G, A, and (as applicable to joint substrates indicated) O.

1. Additional Movement Capability: Provide sealant with the capability to withstand 33 percent movement in both extension and compression for a total of 66 percent movement.

C. Multi-Component, Non-Sag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.

1. Additional Movement Capability: Provide sealant with the capability to withstand 40 percent movement in extension and 25 percent in compression for a total of 65 percent movement in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, and remain in compliance with other requirements of ASTM C 920 for uses indicated.

D. Single-Component, Non-Sag, Urethane Sealant: Type S; Grade NS; Class 25; and Uses NT, M, A, and (as applicable to joint substrates indicated) O.

2.5 PRE-FORMED FIRE RESISTIVE MATERIALS FOR JOINTS

A. Firestop Top Track Seal: One-piece, pre-formed, polyurethane foam based, firestop seal for use with standard head-joint top tracks and slip-type head joints in fire-rated construction at top of partition to maintain continuity of the fire-resistance-rated assembly indicated. Provide in width and configuration required to accommodate depth and installation of studs and designed to saddle-over the top track.

1. Use only firestop top track seal product that has been UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, space requirements and fire-rating required for each application.

2. Performance Requirements:

a. Movement: +/- 50 percent.
b. Surface Burning Characteristics (U.L. 723) ASTM E84: Flame Spread: 10; Smoke Development: 20.
c. Mold-Mildew Performance (ASTM G21-96): Class 0.
d. VOC (LEED): 0.18 lb./gallon.
e. LBC (Living Building Challenge) compliant; International Living Future Institute, 1501 East Madison Street, Suite 150, Seattle WA. 98122.

3. Basis of Design: Hilti Firestop Top Track Seal (CFS-TTS).

B. Perimeter Fire Barrier System: One-piece, pre-formed, polyurethane foam based, firestop seal for use with building perimeter joints between fire-resistance-rated floors and exterior wall assemblies.

1. Use only firestop perimeter joint device that has been ASTM E2307 tested for specific fire-rated construction conditions conforming to construction assembly type, space requirements, and fire-rating required for each application.

2. Basis of Design: Hilti Edge of Slab QuickSeal (CFS-EOS QS).

2.6 MINERAL FIBER/CERAMIC WOOL NON-COMBUSTIBLE INSULATION (FIRE SAFING)

A. Provide min. 4 pcf safing insulation; Thermafiber Safing Mineral Wool Insulation by Thermafiber, Inc. (an Owens Corning company), Roxul Safe Fire Safing Insulation by Rockwool, Mineral Wool Safing by Johns Manville or approved equal to suit conditions and to comply with fire resistance and firestop manufacturer's requirements.

B. Material shall be classified non-combustible when tested per ASTM E 136.

C. For pre-condensed mineral wool products, the following shall serve as the basis of design:

1. Hilti Speed Plug (CP 777).

2. Hilti Speed Strips (CP 767).

3. Hilti Top Track Plug (CFS-TTS MD P FS).

4. Hilti Top Track Cover (CFS-TTS MD C FS).

2.7 MIXING

A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions with Installer present, for compliance with requirements for opening configuration, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing seal of firestopping with substrates.

3.3 CONDITIONS REQUIRING FIRESTOPPING

A. Building Exterior Perimeters

1. Where exterior facing construction is continuous past a structural floor, and a space (i.e. construction joint) would otherwise remain open between the inner face of the wall construction and the outer perimeter edge of the structural floor, provide firestopping to equal the fire resistance of the floor assembly.

   a. If mineral wool is part of firestop system, the mineral wool must be completely covered by appropriate thickness of UL or Warnock Hersey listed firestop sealant or spray.
   b. Refer to Article 3.6 herein for description of fire safing insulation.

2. Firestopping shall be provided whether or not there are any clips, angles, plates, or other members bridging or interconnecting the facing and floor systems, and whether or not such items are continuous.

3. Where an exterior wall passes a perimeter structural member, such as a girder, beam, or spandrel, and the finish on the interior wall face does not continue up to close with the underside of the structural floor above, thus interrupting the fire-resistive integrity of the wall system, and a space would otherwise remain open between the interior face of the wall and the structural member, provide firestopping to continuously fill such open space.

B. Interior Walls and Partitions

1. Construction joints between top of fire rated walls and underside of floors above, shall be firestopped.

2. Firestop system installed shall have been tested by either UL or Omega Point, including exposure to hose stream test and including for use with steel fluted deck floor assemblies.

3. Firestop system used shall allow for deflection of floor above.

C. Penetrations

1. Penetrations include conduit, cable, wire, pipe, duct, or other elements which pass through one or both outer surfaces of a fire rated floor, wall, or partition.

2. Except for floors on grade, where a penetration occurs through a structural floor or roof and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof, provide firestopping to fill such spaces in accordance with ASTM E 814.

3. These requirements for penetrations shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, firestop annular space, if any, between sleeve and wall of opening.

D. Provide firestopping to fill miscellaneous voids and openings in fire rated construction in a manner essentially the same as specified herein before.

3.4 INSTALLING THROUGH PENETRATION FIRESTOPS

A. General: Comply with the through penetrations firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for through penetration firestop systems by proven techniques to produce the following results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.5 INSTALLING FIRE RESISTIVE JOINT SEALANTS

A. General: Comply with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire resistance rating required.

C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint

configuration, and providing uniform, cross sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

D. Tool no sag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.6 INSTALLING FIRESAFING INSULATION

A. Install fire safing insulation utilizing welded or screw applied galvanized steel impaling pins and retaining clips; space clips or pins 24" o.c. maximum.

B. Completely fill voids in areas where safing insulation is required. At spandrel conditions/floor edges, depth of insulation top to bottom shall be at least four (4) inches.

C. Cover top of all safing insulation with firestop sealant or spray.

3.7 FIELD QUALITY CONTROL

A. Inspecting agency employed and paid by the Owner will examine completed firestopping to determine, in general, if it is being installed in compliance with requirements.

B. Inspecting agency will report observations promptly and in writing to Contractor, Owner and Architect.

C. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.

D. Where deficiencies are found, Contractor must repair or replace firestopping so that it complies with requirements.

3.8 CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which openings and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to product firestopping complying with specified requirements.

END OF SECTION

SECTION 079200

JOINT SEALERS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the joint sealers work as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Flashing reglets and retainers.
2. Coping joints.
3. Exterior wall joints not specified to be sealed in other Sections of work.
4. Interior wall joints not specified to be sealed in other Sections of work, including caulking to fill between architectural woodwork and any wall, floor and/or ceiling imperfections.
5. Control and expansion joints in walls.
6. Joints at wall penetrations.
7. Joints between items of equipment and other construction.
8. All other joints required to be sealed to provide a positive barrier against penetration of air and moisture.

1.3 RELATED SECTIONS

A. Roofing - Division 7.

B. Firestop sealants - Section 078413.

C. Sealant at metal-to-metal components of curtain wall - Section 084413.

D. Glazing sealants - Section 088000.

E. Sealant within drywall construction - Section 092900.

F. Sealant at tile work - Section 093013.

G. Sealant at paving - Division 32.

1.4 QUALITY ASSURANCE

A. Qualification of Installers: Use only personnel who are thoroughly familiar, skilled and specially trained in the techniques of sealant work, and who are completely familiar with the published recommendations of the sealant manufacturer.

B. Pre-Construction Field Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to project joint substrates according to the method in ASTM C 794 and C 1521 that is appropriate for the types of Project joints.

C. Perform testing per ASTM C 1248 on interior and exterior sealants to determine if sealants or primers will stain adjacent surfaces. No sealant work shall start until results of these tests have been submitted and the Architect has given written approval to proceed with the work.

1.5 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing all joint conditions, indicating relation of adjacent materials, all sealant materials (sealant, bond breakers, backing, primers, etc.), and method of installation.

1. Submit joint sizing calculations certifying that movement capability of sealant is not being exceeded.

B. Samples: Submit the following:

1. Color samples of sealants, submit physical samples (not color chart).

2. Sealant bond breaker and joint backing.

C. Product Data: Submit manufacturer's technical information and installation instructions for:

1. Sealant materials, indicating that material meets standards specified herein.

2. Backing rods.

D. Submit manufacturer's certification as required by Article 1.6 herein.

E. Submit results of testing required in Article 1.4 herein.

1.6 MANUFACTURER'S RESPONSIBILITY AND CERTIFICATION

A. Contractor shall require sealant manufacturer to review the Project joint conditions and details for this Section of the work. Contractor shall submit to the Architect written certification from the sealant manufacturer that joints are of the proper size and design, that the materials supplied are compatible with adjacent materials and backing, that the materials will properly perform to provide permanent watertight, airtight or vaportight seals (as applicable), and that materials supplied meet specified performance requirements.

1.7 ENVIRONMENTAL CONDITIONS

A. Temperature: Install all work of this Section when air temperature is above forty (40) degrees F. and below eighty (80) degrees F., unless manufacturer submits written instructions permitting sealant use outside of this temperature range.

B. Moisture: Do not apply work of this Section on surfaces which are wet, damp, or have frost.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protection: Use all means necessary to protect the materials of this Section, before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

C. Storage

1. Store sealant materials and equipment under conditions recommended by their manufacturer.

2. Do not use materials stored for a period of time exceeding the maximum recommended shelf life of the material.

3. Material shall be stored in unopened containers with manufacturers' name, batch number and date when shelf life expires.

1.9 WARRANTY

A. Provide a written, notarized warranty from the manufacturer stating that the applied sealants shall show no material failure for a period of twenty (20) years.

B. Contractor to provide a written, notarized warranty stating that the applied sealants shall show no failure due to improper installation for a period of five (5) years.

C. Warranty shall be in a form acceptable to the Owner and executed by an authorized individual.

D. Include in the warranty an agreement to repair and/or replace, at the Contractor's expense, sealant defects that develop during the warranty period as a result of faulty labor and/or materials.

PART 2 PRODUCTS

2.1 SEALANT MATERIALS

A. Exterior Wall Sealant: Provide one (1) part non-sag sealant equal to "DOWSIL 790" or "DOWSIL 795" made by The Dow Chemical Company, "Silpruf SCS 2000" or "LM SCS 2700" made by G.E., "Spectrem 1" or "Spectrem 3" made by Tremco conforming to the minimum standards of ASTM C 920, Type S, Grade NS, Class 50.

B. Interior Sealant: Provide a one (1) part acrylic-based sealant conforming to ASTM C 834, equal to "AC-20+ Silicone" made by Pecora, Masterseal NP 520 by BASF or equal made by Tremco.

C. Colors: Colors selected from manufacturer's standard selection.

2.2 MISCELLANEOUS MATERIALS

A. Back-Up Materials: Provide back-up materials and preformed joint fillers, non-staining, non-absorbent, compatible with sealant and primer, and of a resilient nature, equal to "HBR" made by Nomaco Inc. or approved equal, twenty-five (25) percent wider than joint width. Materials impregnated with oil, bitumen or similar materials shall not be used. Provide back-up materials only as recommended by sealant manufacturer in writing.

B. Provide bond breakers, where required, of polyethylene tape as recommended by manufacturer of sealant.

C. Provide primers recommended by the sealant manufacturer for each material to receive sealant. Note that each exterior joint must be primed prior to sealing.

D. Provide solvent, cleaning agents and other accessory materials as recommended by the sealant manufacturer.

E. Materials shall be delivered to the job in sealed containers with manufacturer's original labels attached. Materials shall be used per manufacturer's printed instructions.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where joint sealers are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with instructions and recommendations of the manufacturer and in accordance with ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions required by this Project where more stringent installation requirements are specified herein, such requirements shall apply.

B. Sample Section of Sealant

1. During sealant installation work in exterior wall, the manufacturer of sealant shall send their representative to the site, under whose supervision a section of the wall (used as "control section") shall be completed for purposes of determining performance characteristics of sealant in joints. Architect shall be informed of time and place of such installation of control section.

2. Control section shall be installed according to specification given herein and shall not be considered as acceptable until written acceptance is provided by the Architect.

3. Accepted control section shall be standard to which all other sealant work must conform.

C. Supervision: The Contractor shall submit to the Architect written certification from the sealant manufacturer that the applicators have been instructed in the proper application of their materials. The Contractor shall use only skilled and experienced workmen for installation of sealant.

D. Apply sealant under pressure with a hand or power actuated gun or other appropriate means. Gun shall have nozzle of proper size and provide sufficient pressure to completely fill joints as detailed. Neatly point or tool joint to provide the contour as indicated on the drawings.

E. Preparation and Application

1. Thoroughly clean all joints, removing all foreign matter such as dust, oil, grease, water, surface dirt and frost. Sealant must be applied to the base surface. Previously applied film must be entirely removed.

2. Stone, masonry and concrete surfaces to receive sealant shall be cleaned where necessary by grinding, water blast cleaning, mechanical abrading, or combination of these methods as required to provide a clean, sound base surface for sealant adhesion.

   a. Do not use any acid or other material which might stain surfaces.
   b. Remove laitance by grinding or mechanical abrading.
   c. Remove loose particles present or resulting from grinding, abrading, or blast cleaning by blowing out joints with compressed air, oil and water free, or vacuuming joints prior to application of primer or sealant.

3. Clean non-porous surfaces such as metal and glass chemically. Remove protective coatings on metallic surfaces by solvent that leaves no residue and is compatible with sealant. Use solvent and wipe dry with clean, dry lint free paper towels. Do not allow solvent to air dry without wiping. Clean joint areas protected with masking tape or strippable films as above after removal of tape film.

4. Do not seal joints until they are in compliance with drawings, or meet with the control section standard.

5. Joint Size and Sealant Size: Joints to receive sealant shall be at least 1/4" wide. In joint 1/4" to 3/8" wide, sealant shall be 1/4" deep. In joints wider than 3/8" and up to 1" wide, sealant depth shall be one half the joint width. For joints wider than 1", sealant depth shall be as recommended by the sealant manufacturer. Depth of joint is defined as distance from outside face of joint to closest point of the filler.

6. Primer: Thoroughly clean joints and apply primer to all surfaces that will receive sealant. Apply primer on clean, dry surfaces, and prior to installation of joint backing. Completely wet both inner faces of the joint with primer. Mask adjacent

surfaces of joint with non-staining masking tape prior to priming. Apply primer with clean brush and only when temperature is above 45 deg. F.

7. Joint Backing: In joints where depth of joint exceeds required depth of sealant, install joint backing (after primer is dry) in joints to provide backing and proper joint shape for sealant. Proper shape for sealant is a very slight "hourglass" shape, with back and front face having slight concave curvature. Use special blunt T-shaped tool or roller to install joint backing to the proper and uniform depth required for the sealant. Joint backing shall be installed with approximately twenty-five (25) percent compressions. Do not stretch, twist, braid, puncture, or tear joint backing. Butt joint backing at intersections.

8. Bond Breaker: Install bond breaker smoothly over joint backing so that sealant adheres only to the sides of the joint and not backing.

9. Sealant Application: Apply sealant in accordance with the manufacturer's application manual and manufacturer's instructions, using hand guns or pressure equipment, on clean, dry, properly prepared substrates, completely filling joints to eliminate air pockets and voids. Mask adjacent surfaces of joint with non-staining masking tape. Force sealant into joint in front of the tip of the "caulking gun" (not pulled after it) and force sealant against sides to make uniform contact with sides of joint and to prevent entrapped air or pulling of sealant off of sides. Fill sealant space solid with sealant.

10. Tooling: Tool exposed joints to form smooth and uniform beds, with slightly concave surface conforming to joint configuration per Figure 5A in ASTM C 1193. Finished joints shall be straight, uniform, smooth and neatly finished. Remove masking tape immediately after tooling of sealant and before sealant face starts to "skin" over. Neatly remove any excess sealant from adjacent surfaces of joint, leaving the work in a neat, clean condition.

11. Replace sealant which is damaged during construction process.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

   a. Perform 5 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform one test for each 5,000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.
b. Whether sealant dimensions and configurations comply with specified requirements.
c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

END OF SECTION

SECTION 079500

EXPANSION CONTROL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the expansion joint covers as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Floor expansion joint cover assemblies.
2. Wall expansion joint cover assemblies.
3. Ceiling expansion joint cover assemblies.
4. Roof expansion joint cover assemblies.
5. Expansion joint covers between new and existing construction for walls, floors, ceilings.

B. Fire-rated expansion joint cover assemblies where required.

1.3 RELATED SECTIONS

A. Selective Demolition and Alteration Work - Section 024119.

B. Cast-in-Place Concrete - Section 033000.

C. Unit Masonry - Section 042000.

D. Roofing - Division 7.

E. Painting and Finishing - Section 099000.

1.4 SUBMITTALS

A. Submit product data for each type of expansion joint cover assembly specified, including manufacturer's product specifications, installation instructions, details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Submit shop drawings showing fabrication and installation of expansion joint cover assemblies, including plans, elevations, sections, details of components, joints, splices, and attachments to other units of work.

C. Submit samples for verification purposes in full size units of each type of expansion joint cover assembly indicated; within sets for each finish, color, texture, and pattern specified, showing full range of variations expected in these characteristics. Install elastomeric material for joints, samples to verify color selected.

1.5 QUALITY ASSURANCE

A. Fire Test Response Characteristics: Where indicated, provide expansion joint cover assemblies identical to those assemblies whose fire resistance has been determined per ANSI/UL 263, NFPA 251, U.B.C. 43-1, or ASTM E 119, including hose stream test of vertical wall assemblies, by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire Resistance Ratings: Rating as shown on drawings and Specifications.

B. Joint covers shall permit unrestrained movement of joint without disengagement of cover.

C. Provide a single source manufacture for all expansion joints in order to maintain manufacturer's warrantee for factory fabricated transitions for both cover and fire barrier.

D. Floor joint cover plate assemblies shall be capable of supporting a 200 psf uniform load and a 300 lb. concentrated load with a deflection not to exceed 1/16".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary protective cover on finished surfaces.

B. Deliver joint covers to jobsite in new, clean, unopened crates of sufficient size and strength to protect materials during transit.

C. Store components in original containers in a clean, dry location.

D. Handle components with equipment of sufficient size to preclude hazard to personnel or components.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Subject to compliance with requirements specified, acceptable manufacturers include Balco/Metalines, Construction Specialties, MM Systems, Watson Bowman Acme, or approved equal.

2.2 MATERIALS

A. Aluminum: ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 6061-T6, sheet and plate; aluminum to have the following finishes:

1. Interior and exterior walking surfaces shall have clear anodized (A41) finish.

2. Exterior surfaces not subject to pedestrian traffic shall have a "Kynar 500" finish conforming to NAAMM 605.2; two (2) colors shall be required, one (1) color to match metal siding and the other color to match adjacent concrete surfaces.

3. Interior surfaces not subject to pedestrian traffic shall be shop primed with rust inhibitive primer, minimum 2 mils thick, ready to receive field painted finish.

B. Stainless Steel: ASTM A 666, Type 304, No. 4 finish.

C. Protect metal surfaces to be placed in contact with cementitious materials with a protective coating.

D. Extruded Preformed Seals: Single or multi-cellular elastomeric profiles as classified under ASTM D 2000, designed with or without continuous, longitudinal, internal baffles. Formed to fit compatible frames, in color, as selected by Architect from manufacturer's standard colors.

E. Fire Barriers: Designed for indicated or required dynamic structural movement without material degradation or fatigue when tested according to ASTM E 1399. Tested in maximum joint width condition with a field splice as a component of an expansion joint cover per ANSI/UL 263, NFPA 251, U.B.C. 43-1, or ASTM E 119, including hose stream test of vertical wall assemblies by a nationally recognized testing and inspecting agency acceptable to authorities having jurisdiction.

1. Supply PyroFlex Fire Barrier Sealing System PF Series for Architectural Joints fire-resistive barrier systems that have ratings equal to or greater than the rating of adjacent construction when tested in accordance with the aforementioned standards. Provide specified [1, 2, 3 or 4] hour rated fire barrier expansion joint assembly for floors and/or specified [1, 2 or 3] hour rated fire barrier expansion joint assembly for walls

F. Accessories: Manufacturer's standard anchors, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesive, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.3 EXPANSION JOINT COVER ASSEMBLIES

A. General: Provide expansion joint cover assemblies of design, basic profile, materials, and operation indicated on drawings. Provide units comparable to those indicated or required to accommodate joint size, variations in adjacent surfaces, and dynamic structural movement without material degradation or fatigue when tested according to ASTM E 1399. Furnish units in longest practical lengths to minimize number of end joints. Provide hairline mitered corners where joint changes direction or abuts other materials. Include closure materials and transition pieces, tee-joints, corners, transition pieces, curbs, cross-connections, and other accessories as required to provide continuous joint cover assemblies.

1. Special conditions shall be shop fabricated.

2. Fabricate components in largest practical lengths to minimize field splicing.

B. Moisture Barrier: Provide manufacturer's continuous, standard, flexible vinyl moisture barrier under covers at locations indicated.

C. All shop drawings shall be signed and sealed by a third-party engineering firm.

D. Fire Rated Joint Covers: Provide expansion joint cover assemblies with manufacturer's continuous, standard, flexible fire barrier seals under covers at locations indicated to provide fire-resistive rating not less than the rating of adjacent construction.

E. All transitions between vertical and horizontal joints shall be factory fabricated.

PART 3 EXECUTION

3.1 PREPARATION

A. Manufacturer's Instructions: In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for phases of Work, including preparing substrate, applying materials, and protecting installed units.

B. Coordinate and furnish anchorages, setting drawings, templates, and instructions for installation of expansion joint cover assemblies to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure expansion joint cover assemblies to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and provide for secure attachment of expansion joint cover assemblies.

3.2 INSTALLATION

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting into new and existing construction as required to install expansion joint covers. Install joint cover assemblies in true alignment and proper relationship to expansion joints and adjoining finished surfaces measured from established lines and levels. Allow adequate free movement of thermal expansion and contraction of metal to avoid buckling. Set floor covers at elevations to be flush. Locate wall, ceiling, roof, and soffit covers in continuous contact with adjacent surfaces. Securely attach in place with required accessories. Locate anchors at interval recommended by manufacturer, but not less than 3" from each end and not more than 24" o.c.

1. Where cutting into existing construction, conform to the requirements of Section 024119.

B. Continuity: Maintain continuity of expansion joint cover assemblies with a minimum number of end joints and align metal members mechanically using splice joints. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials (if any) to frames with adhesive or pressure sensitive tape as recommended by manufacturer.

C. Extruded Preformed Seals: Install seals complying with manufacturer's instructions and with minimum number of end joints. For straight sections provide preformed seals in continual lengths. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seal. Seal transitions according to manufacturer's instructions.

D. Elastomeric Sealant Joint Assemblies: Seal end joints within continuous runs and joints at transitions according to manufacturer's directions to provide a watertight installation.

E. Fire Barriers: Install fire barriers, including transitions and end joints, according to manufacturer's instructions so that fire-rated construction is continuous.

3.3 CLEANING AND PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's instructions.

END OF SECTION

SECTION 081113

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the steel door and frame work as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Interior and exterior hollow metal doors and frames for fire-rated and unrated door openings.
2. Interior hollow metal vision panels.
3. Preparation of metal doors and frames to receive finish hardware, including reinforcements, drilling, and tapping, as necessary.
4. Preparation of hollow metal doors to receive glazing where required.
5. Steel louvers for hollow metal doors.
6. Furnishing anchors for building into masonry and drywall.
7. Factory prime painting of work of this Section.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Carpentry - Section 062000, for installation of doors and frames.

C. Flush Wood Doors - Section 081416.

D. Finish Hardware - Section 087100.

E. Glass and Glazing - Section 088000.

F. Gypsum Drywall - Section 092900.

G. Painting and Finishing - Section 099000.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing custom steel doors and frames similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain custom steel doors and frames through one source from a single manufacturer.

D. Fire-Rated Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40" or less above the sill.

2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-protection-rated door assemblies except for size.

3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating as required by prevailing Building Code in 30 minutes of fire exposure.

4. Fire rated assemblies must have UL approved label.

E. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

F. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, compliance with standards referenced herein, sound and fire-resistance ratings, and finishes for each type of door and frame specified.

B. Shop Drawings: Show fabrication and installation of doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, reinforcement for surface applied hardware, dimensions of profiles and hardware preparation, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessories.

C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Drawings.

1. Coordinate glazing frames and stops with glass and glazing requirements.

D. Oversize Construction Certification: For door assemblies required to be fire rated and exceeding limitations of labeled assemblies, submit certification of a testing agency acceptable to authorities having jurisdiction that each door and frame assembly has been constructed to comply with design, materials, and construction equivalent to requirements for labeled construction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palleted, wrapped, or crated to provide protection during transit and Project site storage. Do not use nonvented plastic.

B. Inspect doors and frames, on delivery, for damage. Minor damage may be repaired provided refinished items match new work and are approved by Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames under cover at building site. Conform to the requirements of ANSI A 250-11-2001 for site storage unless more stringent requirements are noted herein. Place units on minimum 4-inch high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

PART 2 PRODUCTS

2.1 FABRICATION - GENERAL

A. Fabricate hollow metal units to be rigid, neat in appearance and free from defects, warp or buckle. Accurately form metal to required sizes and profiles. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible. Metallic filler to conceal manufacturing defects is not acceptable.

B. Unless otherwise indicated, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.

C. Prepare hollow metal units to receive finish hardware, including cutouts, reinforcing, drilling and tapping in accordance with Finish Hardware Schedule and templates provided by hardware suppliers. Comply with applicable requirements of ANSI A115 "Specifications for Door and Frame Preparation for Hardware."

D. Locate finish hardware as shown on final shop drawings in accordance with locations noted herein.

2.2 MANUFACTURERS

A. Provide products manufactured by Steelcraft, Curries, Ceco Door Products, or approved equal meeting these specifications.

B. Exterior Doors and Frames

1. Basis of Design (Doors): "777E - Trio-E" energy efficient doors by Curries, or approved equal.

2. Basis of Design (Frames): Curries Company (CU) – Mercury Thermal Broken Frames by Curries or approved equal.

2.3 FRAMES

A. Materials

1. Frames for exterior openings shall be made of commercial grade cold-rolled steel conforming to ASTM A 1008, Type B not less than 14 ga., and shall have a hot dipped galvannealed coating conforming to ASTM A 924 and A 653 with A60 coating. The zinc-alloy coating shall be a dull matte surface treated for paint adhesion.

2. Frames for interior openings shall be either commercial grade cold-rolled steel conforming to ASTM A 1008, Type B or commercial grade hot-rolled steel conforming to ASTM A 1011, Commercial Steel, Type B. Metal thickness shall be not less than sixteen (16) ga. for frames in openings 4'-0" or less in width; not less than fourteen (14) ga. for frames in openings over 4'-0" in width.

B. Design and Construction

1. All frames shall be welded units with integral trim, of the sizes and shapes shown on approved shop drawings. Knock-down frames are not permitted.

2. Thermal-Break Frames: Frames shall be subject to the same compliance standards and requirements as standard hollow metal frames. Frames shall be tested for thermal performance in accordance with NFRC 102 and resistance to air infiltration in accordance with NFRC 400. Where indicated, provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weather stripping.

3. All finished work shall be strong and rigid, neat in appearance, square, true and free of defects, warp, or buckle. Molded members shall be clean cut, straight and of uniform profile throughout their lengths.

4. Jamb depths, trim, profile, and backbends shall be as shown on drawings.

   a. Frames at drywall partitions shall be formed with double return backbends to prevent cutting into drywall surface.

5. Welded frames shall have corners mitered and reinforced and faces of welded frames shall be continuously back welded full depth and width of frame conforming to NAAMM Standard HMMA-820; face joints shall be hairline.

6. Minimum depth of stops shall be 5/8".

7. Frames for multiple or special openings shall have mullion and/or rail members which are closed tubular shapes having no visible seams or joints. All joints between faces of abutting members shall be securely welded and finished smooth.

   a. Mullions shall have 16 ga. internal steel stiffeners welded not less than 4" o.c.

8. Hardware Reinforcements

    a. Frames shall be mortised, reinforced, drilled and tapped at the factory for fully-templated, mortised hardware only, in accordance with approved hardware schedule and templates provided by the hardware supplier. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates.
    b. Minimum thickness of hardware reinforcing plates shall be as follows (Contractor shall provide larger and thicker plates as required to accommodate weight of door):
        1). Hinge and pivot reinforcements - seven (7) ga., 1-1/4" x 10" minimum size.
        2). Strike reinforcements - twelve (12) gauge.
        3). Flush bolt reinforcements - twelve (12) gauge.
        4). Closer reinforcements - twelve (12) gauge.
        5). Reinforcements for surface mounted hardware - twelve (12) gauge.

9. Floor Anchors

    a. Provide adjustable floor anchors, providing not less than two (2) inch height adjustment.
    b. Minimum thickness of floor anchors shall be fourteen (14) gauge.

10. Jamb Anchors

    a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the wire type. Anchors shall be not less than 0.156" diameter steel wire. The number of anchors provided on each jamb shall be as follows:
        1). Frames up to 7'-6" height - three (3) anchors.
        2). Frames 7'-6" to 8'-0" height - four (4) anchors.
        3). Frames over 8'-0" height - one (1) anchor for each 2'-0" or fraction thereof in height.
    b. Frames for installation in stud partitions shall be provided with steel anchors of suitable design, not less than eighteen (18) gauge thickness, securely welded inside each jamb as follows:
        1). Frames up to 7'-6" height - four (4) anchors.
        2). Frames 7'-6" to 8'-0" height - five (5) anchors.
        3). Frames over 8'-0" height - five (5) anchors plus one additional for each 2'-0" or fraction thereof over 8'-0".
    c. Frames to be anchored to previously placed concrete or masonry shall be provided with minimum 3/8" concealed bolts set into expansion shields or inserts at six (6) inches from top and bottom and twenty-four (24) inches o.c. Reinforce frames at anchor locations with sixteen (16) gauge sheet steel stiffeners welded to frame at each anchor.

11. Anchors in exterior frames and in masonry walls shall be hot dip galvanized per ASTM A 153.

12. Frames for installation in masonry wall openings more than 4'-0" in width shall have an angle or channel stiffener factory welded into the head. Such stiffeners

shall be not less than twelve (12) gauge steel and not longer than the opening width. Stiffeners shall not be used as lintels or load bearing members.

13. Dust cover boxes (or mortar guards) of not thinner than twenty-six (26) gauge steel shall be provided at all hardware mortises on frames to be set in masonry or plaster partitions.

14. Ceiling Struts: Minimum 3/8" thick x 2" wide steel.

15. All frames shall be provided with a steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping and handling.

16. Loose glazing stops shall be of cold rolled steel, not less than twenty (20) gauge thickness, butted at corner joints and secured to the frame with countersunk cadmium-or zinc-plated screws. Interior frames may be provided with snap-on glazing stops.

17. Except on weatherstripped frames, drill stops to receive three (3) silencers on strike jambs of single door frames and two (2) silencers on heads of double-door frames.

C. Finish: After fabrication, all tool marks and surface imperfections shall be removed, and exposed faces of all welded joints shall be dressed smooth. Frames shall then be chemically treated to insure maximum paint adhesion and shall be coated on all surfaces with one coat of rust-inhibitive baked-on alkyd primer standard with the manufacturer which is fully cured before shipment to a dry film thickness of 2.0 mils.

1. Frames set in masonry walls shall be grouted in as described in Section 042000, "Unit Masonry." These frames shall have surfaces in contact with grout shop coated with epoxy coating equal to Series 27 FC Typoxy made by Tnemec or approved equal spray applied at 4 to 6 mils, passing NFPA 101, Class A for smoke and flame spread, tested per ASTM E 84.

2.4 HOLLOW METAL DOORS

A. Materials: Doors shall be made of commercial quality, level, cold rolled steel conforming to ASTM A 1008, Commercial Steel, Type B and free of scale, pitting or other surface defects. Face sheets for interior doors shall be not less than eighteen (18) gauge. Face sheets for exterior doors shall be not less than sixteen (16) gauge and shall have a hot dipped galvannealed coating conforming to ASTM A 924 and A 653, A60 coating. The zinc alloy coating shall be a dull matte surface treated for paint adhesion.

B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level.

1. Design: Flush panel.

2. Core Construction: Foamed-in-place polyurethane and steel-reinforced core with no stiffener face welds.

a. Provide 16 gauge steel vertical reinforcements 6 inches apart and welded in place. Foamed-in-place polyurethane core shall be chemically bonded to all interior surfaces. No face welding is permitted.
b. Thermal properties to rate at a fully operable minimum U-Factor 0.374 and R-Value 2.53, including insulated door, Mercury thermal-break frame and threshold.
c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.378 and R-Value 2.5, including insulated door, kerf type frame, and threshold.

C. Design and Construction

1. All doors shall be of the types and sizes shown on the approved shop drawings and shall be fully-welded, seamless construction with no visible seams or joints on their faces or vertical edges. Minimum door thickness shall be 1-3/4".

2. All doors shall be strong, rigid, and neat in appearance, free from warpage or buckles. Corner bends shall be true and straight and of minimum radius for the gauge of metal used.

3. Face sheets shall be stiffened by continuous vertical formed steel sections spanning the full thickness of the interior space between door faces. These stiffeners shall be not less than twenty-two (22) gauge spaced not more than six (6) inches apart and securely attached to face sheets by spot welds not more than five (5) inches o.c. Spaces between stiffeners shall be sound deadened and thermal insulated the full height of the door with an inorganic non-combustible batt type material.

4. Door faces shall be joined at their vertical edges by a continuous weld extending the full height of the door. All such welds shall be ground, filled and dressed smooth to make them invisible and provide a smooth flush surface.

5. Top and bottom edges of all doors shall be closed with a continuous recessed steel channel not less than fourteen (14) gauge, extending the full width of the door and spot welded to both faces. Exterior doors shall have an additional flush closing channel at their top edges and, where required for attachment of weatherstripping, a flush closure also at their bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.

6. Edge profiles shall be provided on both vertical edges of doors as follows:

   a. Single-Acting Swing Doors: Beveled 1/8" in two (2) inches.
   b. Double-Acting Swing Doors: Rounded on 2-1/8" radius.
   c. No square edge doors permitted.

7. Hardware Reinforcements

   a. Doors shall be mortised, reinforced, drilled and tapped at the factory for fully templated hardware only in accord with the approved hardware schedule and templates provided by the hardware supplier. Where surface-mounted hardware (or hardware, the interrelation of which is to be adjusted upon installation - such as top and bottom pivots, floor closers, etc.) is to be applied, doors shall have reinforcing plates.

b. Minimum gauges for hardware reinforcing plates shall be as follows (Contractor shall provide larger and thicker plates as required to accommodate weight of door):
   1). Hinge and pivot reinforcement - seven (7) gauge.
   2). Reinforcement for lock face, flush bolts, concealed holders, concealed or surface mounted closers - twelve (12) gauge.
   3). Reinforcements for all other surface mounted hardware - sixteen (16) gauge.

8. Glass Moldings and Stops

   a. Where specified or scheduled, doors shall be provided with hollow metal moldings to secure glazing by others in accordance with glass opening sizes shown on drawings.
   b. Fixed moldings shall be securely welded to the door on the security side.
   c. Loose stops shall be not less than twenty (20) gauge steel, with mitered corner joints, secured to the framed opening by cadmium or zinc-coated countersunk screws spaced eight (8) inches o.c. Snap-on attachments will not be permitted. Stops shall be flush with face of door.

9. Louvers shall be sixteen (16) gauge sheet steel, stationary type, closely spaced inverted "V" blade design, flush with face sheets of door, integral with and welded to door. Fifty (50) percent free area, unless indicated otherwise on drawings.

D. Finish: After fabrication, all tool marks and surface imperfections shall be dressed, filled and sanded as required to make all faces and vertical edges smooth, level and free of all irregularities. Doors shall then be chemically treated to insure maximum paint adhesion and shall be coated, on all exposed surfaces, with manufacturer's standard rust-inhibitive alkyd primer as specified for frames which shall be fully cured before shipment.

E. Flatness: Doors shall maintain a flatness tolerance of 1/16" maximum, in any direction, including in a diagonal direction.

2.5 LABELED DOORS AND FRAMES

A. Labeled doors and frames shall be provided for those openings requiring fire protection ratings as scheduled on drawings. Such doors and frames shall be labeled by Underwriters' Laboratories or other nationally recognized agency having a factory inspection service.

B. If any door or frame specified by the Architect to be fire-rated cannot qualify for appropriate labeling because of its design, size, hardware or any other reason, the Architect shall be so advised before fabricating work on that item is started.

2.6 HARDWARE LOCATIONS

A. The location of hardware on doors and frames shall be as noted in "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames" of the Door Hardware Institute unless otherwise required by prevailing Handicapped Codes.

2.7 CLEARANCES

A. Fabricate doors and frames to meet edge clearances as follows:

1. Jambs and Head: 1/8" plus or minus 1/16".

2. Meeting Edges, Pairs of Doors: 1/8" plus or minus 1/16".

3. Bottom: 3/8" at threshold; 3/4" if no threshold.

B. Fire-rated doors shall have clearances as required by NFPA 80.

2.8 MANUFACTURING TOLERANCES

A. Manufacturing tolerance shall be maintained within the limits given in HMMA 841 of ANSI/NAAMM, current edition.

2.9 PREPARATION FOR FINISH HARDWARE

A. Prepare door and frames to receive hardware:

1. Hardware supplier shall furnish hollow metal manufacturer approved hardware schedule, hardware templates, and samples of physical hardware where necessary to insure correct fitting and installation.

2. Preparation includes sinkages and cut-outs for mortise and concealed hardware.

B. Provide reinforcements for both concealed and surface applied hardware:

1. Drill and tap mortise reinforcements at factory, using templates.

2. Install reinforcements with concealed connections designed to develop full strength of reinforcements.

2.10 REJECTION

A. Hollow metal frames or doors which are defective, have hardware cutouts of improper size or location, or which prevent proper installation of doors, hardware, or work of other trades, shall be removed and replaced with new at no cost.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where steel doors and frames are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Refer to Section 062000 for installation procedures for all work of this Section.

END OF SECTION

SECTION 081416

FLUSH WOOD DOORS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the wood doors as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Solid core flush wood doors.

2. Fire-rated flush wood doors.

1.3 RELATED SECTIONS

A. Carpentry - Section 062000, for installation of wood doors.

B. Steel Doors and Frames - Section 081113, for hollow metal frames.

C. Finish Hardware - Section 087100.

D. Glass and Glazing - Section 088000.

E. Painting and Finishing - Section 099000, for field painting of wood doors.

1.4 SUBMITTALS

A. Product Data: Submit door manufacturer's product data, specifications and installation instructions for each type of wood door.

1. Include details of core and edge construction and trim for openings.

2. Include factory finish specifications.

3. Include certifications to show compliance with specifications.

4. Include certification to show compliance with AWI and WDMA requirements specified herein.

B. Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for finishing and other pertinent data.

1. Include requirements for veneer matching.

C. Submit samples of factory finishes applied to actual door face materials, approximately 8 by 10 inches for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated"; latest edition "Premium" grade and WDMA "Extra Heavy Duty" Performance Level.

1. Only manufacturers that are certified and listed by AWI to be QCP qualified are acceptable for this project.

2. Provide letter of licensing for Project indicating that doors comply with requirements of grade specified.

C. Fire-Rated Wood Doors: Doors complying with Category A, Positive Pressure or Neutral Pressure testing standards per UBC 7-2-1997 and UL 10C (UBC 7-2-1994 and UL 10B) that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated on Door Schedule, based on testing according to NFPA 252.

1. Conform to prevailing Code requirements to determine which pressure standard (Positive or Neutral) is required.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) in excess of permitted standard noted in Article 2.2 herein, or show telegraphing of core construction in face veneers.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

2. Warranty shall be in effect for the life of the installation starting from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SOLID CORE FLUSH WOOD DOORS

A. Provide AWI PC-5 Premium Grade hot pressed 5-ply solid core particleboard doors, 1-3/4" thick, conforming to standards specified herein. Subject to meeting standards specified herein, the following manufacturers are acceptable: Marshfield Door Systems, Inc., Algoma Hardwoods Inc., or Eggers Industries.

1. Core shall consist of a formed flat panel consisting of wood particles bonded together with synthetic resins or other added binder, with an average density of 30 to 32 lbs. per cubic foot. The material shall meet or exceed the requirements of ANSI A208.1, Grade 1-LD-2 covering mat formed particleboard with face screw holding of 124 lbs., modulus of rupture of minimum 700 psi and modulus of elasticity of not less than 148,000 psi.

2. Core shall be capable of satisfying this WDMA TM-7 cycle slam test for 1 million slams for surface mounted hardware. Where the manufacturer's core does not meet this criterion, stiles and rails must measure a minimum of 5-1/2" and must be fabricated of hardwood.

a. Surface mounted hardware must be installed with minimum 1-1/4" screw penetrations using threaded to the head screws; coordinate with Section 087100.

B. Cross Bands: Shall be 1/16" thick hardwood extending full width of door and laid with grain at right angles to face veneers. Cross bands and faces shall be laminated to the core with Type I MF or PVA glue.

C. Stiles, Rails: Stile and rail shall be a minimum of 1-3/8" solid hardwood or structural composite lumber (after trimming) laminated to the core. Stiles and rails must be securely glued to the core with no voids allowed. Stiles and rails must be capable of screw holding of 550 lbs. per WDMA TM-10.

D. Transparent Finish: Finish in the shop with clear satin catalyzed polyurethane finish conforming to AWI System "Catalyzed Polyurethane Transparent."

1. Doors with Transparent F: Provide center balanced, slip matched, plain sliced, Select white maple, factory-stained to match Architect's control sample, conforming to AWI, "AA" grade veneer with 3" wide leaf. Minimum veneer thickness shall be not less than 1/50" after sanding.

2. Veneers shall be continuous or end matched at transoms.

E. Opaque Finish: For doors to be field painted, shop prime on all surfaces with one coat of alkyd wood primer applied to a dry film thickness of 1.5 mils.

1. Doors to be field painted shall have MDO or hardboard face.

F. Where glass lites are noted, factory cut openings. Trim openings with solid hardwood moldings of same type of wood as face veneer.

1. Lite openings in 20-minute rated doors shall have manufacturer's 20-minute approved hardwood system.

G. Doors shall have hinge-loading capacity of 500 lbs. per WDMA TM-8.

H. Vertical door edge must be capable of screw holding of 550 lbs. per WDMA TM-10; horizontal door edge must be capable of screw holding of 400 lbs. per WDMA TM-10.

I. Fire-Rated Wood Doors: Provide mineral core 1-3/4" thick solid core wood doors conforming to standards specified herein, manufactured by one of the manufacturers noted above. Stile construction on both stiles shall conform to the following:

1. Stile edge screw withdrawals when tested in accordance with ASTM D 1037-12 shall exceed 650 lbs. This applies to both stiles.

2. Stile edge split resistance when tested in accordance with ASTM D 143-14 Modified must exceed 950 lbs. This applies to both stiles.

3. Door to have face finish as specified above.

a. Where the core is free of urea formaldehyde, provide a layer of veneer over the substrate prior to application of finish veneer to prevent telegraphing of patterns from the adhesive.

4. Blocking: For surface mounted hardware only, provide composite blocking designed to maintain fire resistance of door but with improved screw-holding capability of same thickness as core and with minimum dimensions as follows:

a. 5-inch top rail blocking.
b. 5-inch bottom rail blocking.
c. 1 – 5" x 18" lock block at cylinder or mortise locksets.
d. 2 – 5" x 18" lock blocks at exit devices.

5. Pairs: Provide fire-rated pairs with fire-retardant stiles that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals.

2.2 FABRICATION

A. Prefit and premachine wood doors at the factory.

B. Comply with the tolerance requirements specified herein. Machine doors for hardware requiring cutting of doors. Comply with final hardware scheduled and door frame shop drawings, and with hardware templates and other essential information required to ensure proper fit of doors and hardware.

C. Take accurate field measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with machining in the factory.

D. Doors shall be factory sized to door opening so that trimming and fitting are not required in the field.

E. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances unless otherwise indicated.

1. Three-degree bevel or bevel to suit frame sizes indicated, with 3/16" prefit in width, +0/-1/32" tolerances. Prefit top of door 1/8" + 1/16"/-0" and undercut as required by floor condition. Undercut shall not exceed 1/8" from bottom of door to top of finished floor; where threshold occurs undercut shall not exceed 1/8" from bottom of door to top of threshold.

2. Comply with requirements in NFPA 80 for fire-rated doors.

F. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3 unless otherwise noted. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2. Provide concealed intumescent seals at fire-rated pairs of doors meeting the requirements of U.L. 10 C.

G. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kinds of doors required.

H. Once wood doors are installed, maximum allowable warp, bow, cut or twist in doors shall be 1/16" as measured by the 1/16-inch feeler gauge and a straight-edge extending from corner to corner of the door face at stiles, top and bottom rails and along both diagonals.

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Section 062000 for installation of wood doors.

END OF SECTION

SECTION 081613

FIBERGLASS DOORS AND FRAMES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the fiberglass doors and frames as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Fiberglass reinforced polyester (FRP) doors and frames.

1.3 RELATED SECTIONS

A. Finish Hardware - Section 087100.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.

B. Air Infiltration: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 283 at pressure differential of 6.24 psf. Door shall not exceed 0.90 cfm per linear foot of perimeter crack.

C. Water Resistance: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 331 at pressure differential of 7.50 psf. Door shall not have water leakage.

D. Swinging Door Cycle Test, Doors and Frames, ANSI A250.4: Minimum of 12,000,000 cycles.

E. Swinging Security Door Assembly, Doors and Frames, ASTM F 476: Grade 40.

F. Salt Spray, Exterior Doors and Frames, ASTM B 117: Minimum of 500 hours.

G. Sound Transmission, Exterior Doors, STC, ASTM E 90: Minimum of 25.

H. Thermal Transmission, Exterior Doors, U-Value, AAMA 1503.1: Maximum of 0.09 BTU/hr x sf x degrees F.

I. Surface Burning Characteristics, FRP Doors and Panels, ASTM E 84:

1. Flame Spread: Maximum of 200, Class C.

2. Smoke Developed: Maximum of 450, Class C.

J. Surface Burning Characteristics, Class A Option On Interior Faces of FRP Exterior Panels and Both Faces of FRP Interior Panels, ASTM E 84:

1. Flame Spread: Maximum of 25.

2. Smoke Developed: Maximum of 450.

K. Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 256: 15.0 foot-pounds per inch of notch.

L. Tensile Strength, FRP Doors and Panels, Nominal Value, ASTM D 638: 14,000 psi.

M. Flexural Strength, FRP Doors and Panels, Nominal Value, ASTM D 790: 21,000 psi.

N. Water Absorption, FRP Doors and Panels, Nominal Value, ASTM D 570: 0.20 percent after 24 hours.

O. Indentation Hardness, FRP Doors and Panels, Nominal Value, ASTM D 2583: 55.

P. Abrasion Resistance, Face Sheet, Taber Abrasion Test, 25 Cycles at 1,000 Gram Weight with CS-17 Wheel: Maximum of 0.029 average weight loss percentage.

Q. Stain Resistance, ASTM D 1308: Face sheet unaffected after exposure to red cabbage, tea, and tomato acid. Stain removed easily with mild abrasive or FRP cleaner when exposed to Sharpie ink pen and white spray paint.

R. Chemical Resistance: ASTM D 543. Excellent rating.

1. Acetic acid, 5 percent solution.

2. Chlorine bleach, 10 percent solution.

3. Sodium hypochlorite, 4 to 6 percent solution.

4. Citric acid, 10 percent solution.

5. Sodium carbonate, 20 percent solution.

6. Turpentine.

S. Compressive Strength, Foam Core, Nominal Value, ASTM D 1621: 84.2 psi.

T. Compressive Modulus, Foam Core, Nominal Value, ASTM D 1621: 448 psi.

U. Tensile Adhesion, Foam Core, Nominal Value, ASTM D 1623: 48 psi.

V. Thermal and Humid Aging, Nominal Value @ 158°F and 100% Humidity for 14 Days, ASTM D 2126: -4.89 Volume Change.

1.5 SUBMITTALS

A. Product Data: Submit door manufacturer’s product data, specifications and installation instructions for each type of door.

B. Shop Drawings:

1. Plans: Indicate location of each door and frame opening assembly in project.

2. Elevations: Dimensioned elevation of each type door opening assembly in project; indicate sizes and locations of door hardware, and lites and louvers, if specified.

3. Details: Installation details of each type installation condition in project; indicate installation details of glazing, if specified.

4. Schedule: Indicate each door opening assembly in project; cross reference to plans, elevations and details.

C. Selection Samples: Manufacturer's standard color chips.

D. Verification Samples: Two (2) samples to verify color match.

E. Manufacturer's Instructions: Printed installation instructions for door opening assemblies.

F. Warranty Documents: Manufacturer's standard warranty documents, executed by manufacturer's representative, countersigned by Contractor.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling and Unloading: Package door opening assemblies in manufacturer's standard containers.

B. Store door assemblies in manufacturer's standard containers, on end, to prevent damage to face corners and edges.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer's ten (10) year warranty against failure due to corrosion from specified environment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Products and Manufacturers: "Tiger Heavy Duty Door Series" as manufactured by Tiger Door or comparable product by Special-Lite, Inc., ChemPruf Door Company, Ltd. or approved equal.

2.2 MATERIALS

A. Fiberglass Mat: Abuse-resistant, 0.120-inch thickness, finish color throughout. Color as selected by Architect.

B. Aluminum Members

1. Extrusions: ASTM B 221.

2. Sheet and Plate: ASTM B 209.

3. Alloy and Temper: As required by manufacturer for strength, corrosion resistance, application of required finish, and control of color.

4. Anodized Finish: Class I finish, 0.7 mils thick. Color as selected by Architect.

C. Anchors: Manufacturer's standard stainless steel expansion anchors for existing openings, and stainless steel masonry tee anchors for new construction.

D. Fasteners: Stainless steel.

2.3 MANUFACTURED UNITS

A. Non-Rated Fiberglass Reinforced Polyester (FRP) Doors:

1. Thickness: 1-3/4.

2. Thermal Insulating Value: 'R' factor 11.

3. Construction:

a. Core: Poured-in-place polyurethane foam, min. 5 lb./cf density.
b. Stiles and Rails: Aluminum Alloy 6063-T5, minimum of 2-5/16-inch depth.
c. Corners: Mitered.
d. Provide joinery of 3/8-inch diameter full-width tie rods through extruded splines top and bottom as standard tubular shaped stiles and rails reinforced to accept hardware as specified.
e. Securing Internal Door Extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.
f. Furnish extruded stiles and rails with integral reglets to accept face sheets. Lock face sheets into place to permit flush appearance.
g. Rail caps or other face sheet capture methods are not acceptable.
h. Extrude top and bottom rail legs for interlocking continuous weather bar.
i. Meeting Stiles: Pile brush weather seals. Extrude meeting stile to include integral pocket to accept pile brush weather seals.
j. Bottom of Door: Install bottom weather bar with nylon brush weatherstripping into extruded interlocking edge of bottom rail.

4. Sizes: Indicated on drawings.

5. Finish: Smooth gloss surface, minimum value 88 in accordance with ASTM D 523.

2.4 FABRICATION

A. Fiberglass Reinforced Polyester (FRP) Doors

1. Fabricate to size and profiles of doors and frames indicated on Drawings.

2. Welding of doors and frames is not acceptable.

3. Maintain continuity of line and accurate relation of panels and angles. Secure attachments and support at mechanical joints with hairline fit at contacting members.

2.5 DOOR FRAMING SYSTEMS

A. Same material as specified above.

2.6 VISION LITES

A. Factory Glazing: 1/4-inch glass.

B. Lites in Exterior Doors: Allow for thermal expansion.

C. Rectangular Lites

1. Size: As indicated on the Drawings

2. Factory glazed with screw-applied aluminum stops anodized to match perimeter door rails.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Openings are correctly prepared to receive doors.

2. Openings are correct size and depth in accordance with shop drawings.

B. Installer’s Examination

1. Have installer examine conditions under which construction activities of this section are to be performed and submit written report if conditions are unacceptable.

2. Transmit two copies of installer's report to Architect within 24 hours of receipt.

3. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.

4. Beginning construction activities of this section indicated installer’s acceptance of conditions.

C. Verify that glazing has been factory installed.

3.2 INSTALLATION

A. Install door opening assemblies in accordance with shop drawings, SDI 100, and manufacturer’s printed installation instructions, using installation methods and materials specified in installation instructions.

B. Installation of door hardware is specified in Section 08700.

C. Install door hardware in accordance with manufacturer’s printed instructions, using through bolts to secure surface applied hardware.

D. Site Tolerances: Maintain plumb and level tolerances specified in manufacturer's printed installation instructions.

3.3 ADJUSTING

A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding, and to remain in place at any angle without being moved by gravitational influence.

B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.

3.4 CLEANING

A. Clean surfaces of door opening assemblies and sight exposed door hardware in accordance with manufacturer's maintenance instructions.

3.5 PROTECTION OF INSTALLED PRODUCTS

A. Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection.

END OF SECTION

SECTION 083113

ACCESS DOORS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the access doors as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Frameless recessed panel access doors at drywall ceilings and walls.

2. Framed flush panel access doors at masonry and tile walls.

3. Provide access doors and frames for access from occupied spaces to the following, where indicated or required, and as directed by the trades of Divisions 23 and 26.

a. All shutoff or balancing valves.
b. Fire dampers, as required.
c. Points of duct access.
d. Pull boxes.
e. Controls of mechanical and electrical items.
f. Masonry shafts for pipes and conduits, as required.
g. Pipe spaces, if required.
h. Inlets of fans.
i. Fusible link and splitter damper at filter bank.
j. Automatic damper and motor.
k. Equipment not otherwise accessible.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Gypsum Drywall - Section 092900.

C. Ceramic Tiling - Section 093013.

D. Valves and connections - Division 23.

1.4 QUALITY ASSURANCE

A. For actual installation of the work of this Section, use only personnel who are thoroughly familiar with the manufacturer's recommended methods of installation and who are completely trained in the skills required.

B. Fire-Resistance Ratings: Wherever a fire-resistance classification is shown, or for construction where access doors are installed, provide required access door assembly with panel door, frame, hinge and latch from manufacturers listed in Underwriters' Laboratories, Inc. "Classified Building Materials Index" for the rating shown.

1. Provide UL label on each access panel.

2. Provide flush, key operated cylinder lock.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units which may vary slightly from sizes shown or scheduled.

1.5 SUBMITTALS

A. Before any materials of this Section are delivered to the job site, submit complete manufacturer's literature to the Architect. Submit plans and schedules showing size and location of each and every access door for Architect's acceptance prior to installation.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 MATERIALS AND FABRICATION

A. Provide access door assembly manufactured by Karp Associates, Inc., Milcor Inc., Nystrom Inc., or approved equal. Assembly shall be an integral unit complete with all parts and ready for installation.

B. Fabricate units of continuous welded steel construction. Grind welds smooth and flush with adjacent surfaces. Provide attachment devices and fasteners of the type required to secure access panels to the types of supports shown.

C. Frames for Masonry and Tile Wall Only (Flush Panel Units): Fabricate frame from sixteen (16) gauge steel. Provide frame with exposed flange not less than one (1) inch wide around perimeter of frame for exposed masonry and tile finishes.

1. For installation in masonry construction, provide frames with adjustable metal masonry anchors.

D. Frameless Units for Drywall Surfaces (Recessed Panel Units): Provide access doors without exposed frames for drywall adhered to recessed panel.

E. Panels: Fabricate from fourteen (14) gauge steel, with concealed spring hinges set to open to 175 degrees. Provide removable pin type hinges of the quantity required to support the access panel sizes used in the work. Finish with manufacturer's factory applied baked enamel prime coat applied over phosphate protective coating on steel.

F. Locking Devices

1. For non-rated access doors, provide flush, screwdriver operated cam locks of number required to hold door in flush, smooth plane when closed.

2. For fire rated doors, provide locks as described in paragraph 1.4, B. herein.

G. Inserts and Anchorage: Furnish inserts and anchoring devices which must be built into masonry for the installation of access panels. Provide setting drawings, templates, instructions, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where access doors are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 COORDINATION

A. Coordinate all work with the mechanical trades to insure proper locations and in a timely manner to permit orderly progress of the total work.

B. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

C. Adjust hardware and panels after installation for proper operation.

D. Remove and replace panels or frames which are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 33 00 COILING FIRE & SMOKE RATED DOORS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Provide all materials, labor, equipment and services necessary to furnish, deliver and install all work under this section as shown on the contract documents, specified herein, and as specified by the job conditions.

1.02 DESCRIPTION

A. Related work specified elsewhere:

1. Metal Fabrication.	Section 05 50 00
2. Rough Carpentry.	Section 06 10 00
3. Access Panels & Doors:	Section 08 31 00
4. Painting:	Section 09 91 00
5. Electrical:	Division 26

1.03 SUBMITTALS

A. Procedures: Furnish submittals in accordance with the general requirements specified.

B. Shop Drawing: Furnish shop drawings for architect's approval. Include elevations, sections, and details indicating dimensions, materials, finishes, conditions for anchorage and support of each shutter.

C. Certifications:
1. Submit manufacturer’s Underwriters Laboratories (UL), Warnock Hersey (WH) or Factory Mutual Research (FM) laboratory test report verifying product compliance in accordance with the required fire and smoke ratings.
2. Submit manufacturer’s Code Compliance Research Report published by an independent third-party testing agency that is certified by the International Accreditation Service confirming compliance of the fire door assembly in accordance with the International Building Code.

D. Product Literature: Submit manufacturer's technical literature describing the product to be used under this section.

E. Maintenance and Operating Manuals: Furnish complete manuals describing the materials, devices and procedures to be followed in operating and maintaining all shutters under this section. Include manufacturer's brochures and parts lists describing the actual materials used in the product.

1.04 QUALITY ASSURANCE

A. Fire & Smoke Rated Assemblies: Provide all shutters with fire and smoke resistance rating required to comply with governing regulations which are inspected, tested, listed and labeled by UL, WH or FM and complying with NFPA 80 for class of opening. Provide units tested in accordance with the requirements of UL 10B, UL 1784, NFPA 252, ASTM E-152. Provide testing laboratory label permanently fastened to each fire and smoke shutter assembly.

B. Regulatory Requirements:
1. Comply with applicable requirements of the laws, codes, ordinances and regulations of federal, state and municipal authorities having jurisdiction.
2. Listed under a certified Code Compliance Research Report in accordance with the applicable

sections of the International Building Code.

C. Manufacturer Requirements: Shutter manufacturer shall have been in the business of and have experience in manufacturing the type of product covered under this specification section as well as giving credible service for a minimum of five (5) years. Provide list of at least ten (10) completed projects which include the products covered under this section.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials in manufacturer's original packaging, labeled to show name, brand and type. Store materials in a protected dry location off the ground in accordance with manufacturer's instructions.

1.06 WARRANTY

A. Shutter Warranty: Provide Two (2) Year Warranty signed by the manufacturer and installer agreeing to repair or replace work which has failed as a result of defects in materials or workmanship. Upon notification within the warranty period, such defects shall be repaired at no cost to the owner.

PART 2 PRODUCTS

2.01 COILING COUNTER FIRE & SMOKE RATED SHUTTERS

A. Manufacturer: Coiling counter fire and smoke rated shutters shall be Auto-Set® System model CFS-FT-PC as manufactured by McKEON.

2.02 MATERIALS

A. Curtain: Shall be assembled of G90 galvanized steel interlocking slats, cold rolled. Slats shall have endlocks locking each end of alternate slats to act as a wearing surface and maintain slat alignment. Curtain shall be 22 gauge minimum or gauge required by UL, WH or FM whichever is greater.
   1. Slats: Shall be of a cross section not less than 1½” wide by ½" deep.

B. Bottom Bar: Shall consist of a single steel angle not less than 1½” x 1½” formed to fit slats.

C. Guides: Each guide assembly shall be fabricated of a minimum 1/8” steel angles and channels formed to a box type configuration. Guides shall be provided with slotted holes to allow for thermal expansion.
   1. Provide internal, fully concealed UL Classified smoke seals located within each guide assembly. Externally mounted smoke seals shall not be acceptable.
   2. Drywall Applications: Provide steel support tubes designed and constructed with a slip joint at the top to allow for thermal expansion.

D. Mounting Brackets: Fabricated of hot rolled 1/8” steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.

E. Hood: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22 gauge G90 galvanized steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness.
   1. Provide UL Classified lintel smoke seals.

F. Counterbalance Assembly: Fire shutter shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.

G. Inboard Tubular Operator: Torque rating as recommended by door manufacturer for size and type of door, 110 volts, 1 phase. Provide complete with an internal tubular operator, fail-safe magnetic release mechanism and maintenance free electric brake. A fully adjustable, mechanical internal worm limit switch mechanism shall synchronize the operator with the shutter.
   1. Motor: Shall be intermediate duty, thermally protected, ball bearing type with a class A or better insulation.
   2. Starter: Shall be size "0" magnetic reversing starter, across the line type with mechanical and electrical interlocks, with 10 amp continuous rating and 24 volt control circuit.
   3. Reducer: Planetary gear type, 80% efficiency minimum.
   4. Brake: Magnetically activated, integral within the operator's housing.
   5. Control Station: Provide flush mount key switch control station marked open, close and stop.

H. Self-Closing Mechanism: The fire shutter is to be designed with a centrifugal governor as an integral part of the operator's construction. The automatic release mechanism shall be activated by a fusible link, smoke detector or fire alarm. When activated the shutter is released and begins to close due to gravitational force. The speed of the shutter is governed by a centrifugal governor, designed to match the normal operating speed of the shutter, at a rate of not greater than 9" per second or less than 6" per second.

I. Magnetic Release with 10 Second Time Delay: A fail-safe magnetic release device shall be built into the operator as an integral part of the release mechanism. When power is interrupted to the release mechanism by the smoke detector or fire alarm, the shutter shall begin to self-close. In the event of power failure the time delay shall prevent the fire shutter from closing for a period of 10 seconds. Once the 10 seconds have lapsed, the fire shutter shall self-close. Once power has been restored to the release mechanism the automatic reset time delay as well as the fire shutter shall automatically reset themselves.

J. Obstruction Sensing Safety Edge: The fire shutter shall be designed with an obstruction sensing safety edge. In the event that the safety edge meets an obstruction during the normal closing operation, the shutter shall stop, reverse and return to the open position. In the event the safety edge meets an obstruction during the self-closing operation, the shutter shall come to rest on the obstruction and once the obstruction has been removed the fire shutter shall continue to the fully closed position.

K. Easy Trip Test Feature: The fire shutter shall be designed so that it may be trip tested simply by cutting power to the operator. By turning the power switch off, the shutter shall self-close. Once the fire shutter has satisfactorily closed, it shall be reset simply by turning the power back on. No ladders or tools shall be needed to reset the shutter or the time delay unit.

L. True Test Panel: Fire shutters shall be provided with a True Test panel. The test panel shall activate all the fire shutters to close via gravity not power and shall be in accordance with NFPA Bulletin 80. Only one test panel shall be required to test all the fire shutters on this project.

M. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for powder coat adhesion. Provide powder coat finish of color as selected by architect from manufacturer’s standard RAL powder coat selection chart.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces and field conditions to which this work is to be performed and notify architect if conditions of surfaces exist which are detrimental to proper installation and timely completion of work.

B. Verify all dimensions taken at job site affecting the work. Notify the architect in any instance where dimensions vary.

C. Coordinate and schedule work under this section with work of other sections so as not to delay job progress.

3.02 INSTALLATION

A. Perform installation using only factory approved and certified representatives of the shutter manufacturer.

B. Install shutter assemblies at locations shown in perfect alignment and elevation, plumb, level, straight and true.

C. Adjust shutter installation to provide uniform clearances and smooth non-binding operation.

D. Install wiring in accordance with applicable local codes and the National Electrical Code Standard. Materials shall be UL listed.

E. Test shutter closing sequence when activated by the building's fire alarm system. Reset shutter after successful test.

3.03 PROTECTION AND CLEANING

A. Protect installed work using adequate and suitable means during and after installation until accepted by owner.

B. Remove, repair or replace materials which have been damaged in any way.

C. Clean surfaces of grime and dirt using acceptable and recommended means and methods.

SECTION 083313

COILING COUNTER DOORS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the coiling counter doors as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Coiling counter doors.
2. Manual operation.
3. Guides, anchors, and hardware required for complete installation and operation.

1.3 RELATED SECTIONS

A. Painting and Finishing - Section 099000.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data, roughing-in diagrams, and installation instructions for each type and size of coiling counter door. Include manufacturer's operating instructions and maintenance data.

B. Shop Drawings: Submit shop drawings indicating location and size of each unit, details for special components, surrounding conditions and installations which are not fully dimensioned or detailed in manufacturer's data.

1.5 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Provide pre-assembled coiling counter door units; Model ESC10 manufactured by Cornell/Cookson or comparable product by Overhead Door Corp., Raynor, or approved equal.

2.2 MATERIAL DESCRIPTION

A. Fabricate coiling counter door curtain of interlocking flat slats fabricated from 22 ga. steel. Each slat to be fitted with endlocks to hold curtain in alignment. Bottom of curtain to be finished with stainless steel angle and lift handle and a continuous neoprene bumper to prevent counter abrasion.

1. Color: Gray painted finish from manufacturer's standard options.

B. Furnish inserts and anchoring devices which must be secured to concrete or built into masonry or drywall assemblies for the installation of the units. Provide setting drawings, templates, instructions, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

2.3 CURTAIN ACCESSORIES

A. Locking Device: Curtain shall be locked at each end of bottom bar by a slide bolt, with padlock keeper, which shall engage a locking wedge in each guide.

B. Barrel and Counterbalance: Curtain to be coiled around a steel pipe fitted with involute shaped rings for ease of operation. Rings to be faced with suitable material to prevent curtain abrasion. Barrel to be of sufficient thickness and diameter to prevent deflection exceeding .03" per ft. Barrel to be supported by plate brackets. Helical, oil-tempered springs shall be installed inside the steel pipe, which shall rotate on self-lubricating bearings. Spring tension shall be adjusted in the field by means of an adjusting wheel.

C. 18 ga. steel hood shall be provided to enclose mechanism and end brackets. Barrel shall be mounted as part of the complete assembly within the hood. At fire rated units, furnish automatic drop baffle to guard against passage of smoke or flame.

D. Provide steel frame consisting of 16 ga. jambs and 14 ga. sill. Form grooves into sides of frames for retaining curtain.

E. Doors shall be manually operated by crank handle.

F. All steel to have manufacturer's standard shop primed finish.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where coiling counter doors are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install units complete with necessary hardware, in accordance with final shop drawings, manufacturer's instructions, and as specified herein.

B. Upon completion of installation, including work by other trades, test, lubricate and adjust doors to operate easily, free from warp, twist, or distortion.

C. Install fire-rated units to comply with NFPA 80.

END OF SECTION

SECTION 084113

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the aluminum entrances and storefronts as indicated on the drawings and/or specified herein, including the following:

1. Exterior entrance systems.

2. Interior entrance systems.

3. Exterior storefront systems.

4. Interior storefront systems.

1.3 RELATED SECTIONS

A. Joint Sealers - Section 079200.

B. Finish Hardware - Section 087100.

C. Glass and Glazing - Section 088000.

1.4 QUALITY ASSURANCE

A. Source: For each material type required for work of this Section, provide primary materials which are products of one manufacturer. Provide secondary or accessory materials which are acceptable to manufacturers of primary materials.

B. Design Criteria: Drawings indicate sizes, member spacings, profiles, and dimensional requirements of work of this Section. Minor deviations will be accepted in order to utilize manufacturer's standard products when, in the Architect's sole judgment, such deviations do not materially detract from the design concept or intended performances.

C. Engineering: Provide services of a Professional Engineer registered in the State of New Jersey to design and certify that work of this Section meets or exceeds performance requirements specified.

D. Installer Qualifications: A qualified glazing contractorcertified under the NorthAmerican Contractor Certification Program (NACC)for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program OR a glazing contractor that can provide the following:

1). Five (5) years of glazing co. ownership and experience
2). Written references to demonstrate evidence of successfully completed similar projects
3). A formal Safety Program documented in writing
4). A formal Quality Manual documented in writing
5). Resume and qualifications for a Quality Manager
6). Evidence of a fully implemented Quality Management System, including installation quality verification metrics to be utilized on the project.

1.5 TESTS AND PERFORMANCE REQUIREMENTS

A. Manufacturer's Standard Tests: Provide manufacturer's standard test data showing compliance with specified requirements.

B. Testing and performance data apply to exterior assemblies.

C. Test Sequence: Test sequence is optional, except that air infiltration tests shall precede water resistance tests.

D. Air Infiltration Test: Test unit in accordance with ASTM E 283, as follows:

1. Static Air Pressure Difference: 6.24 psf for fixed storefront units, and 1.567 psf for doors.

2. Performance: Maximum air leakage shall not exceed Code requirements.

E. Water Leakage Test: Test fixed framing system in accordance with ASTM E 331.

1. Test Pressure: 6.24 psf.

2. Performance: No leakage as defined in test method at specified test pressure.

F. Uniform Load Deflection Test: Test units in accordance with ASTM E 330, at following static air pressure difference (Design Wind Pressure), or loads prescribed by code for this project site, whichever is greater. Apply pressure first to exterior side (positive) and then interior side (negative).

1. Design Wind Pressure: ASCE-7 or Building Code, whichever is more restrictive.

2. Test Procedure: Procedure A as specified in ASTM E 330.

3. Performance: Deflection in each member measured at locations of greatest deflection shall not exceed L/175 at specified Design Wind Pressure.

G. Uniform Load Structural Test: Test units in accordance with ASTM E 330 at following static air pressure difference. Apply high pressure load first on one side and then on other side. At conclusion of test there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms.

1. Static Air Pressure: Minimum 1.5 times the Design Wind Pressure.

2. Permanent Deformation in Any Member: Not to exceed 0.2% of member span.

H. Condensation Resistant Factor: Not less than _____ for fixed storefront units, and not less than ____ for doors; per AAMA 1502.7.

I. Thermal Movement: Provide storefront systems that allow for expansion and contraction of members throughout an ambient temperature range of 120 degrees F.

J. Seismic Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of authorities having jurisdiction or ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 9, "Earthquake Loads," whichever are more stringent.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

B. Shop Drawings: Provide large scale shop drawings for fabrication, installation, and erection of all parts of work. Provide plans, elevations, and details of anchorages, connections, and accessory items. Provide installation templates for work installed by others. Show interfaces and relationships to work of other trades.

C. Field Measurements: Take necessary field measurements before preparation of shop drawings and fabrication. Do not delay progress of job. If field measurements are not possible prior to fabrication, allow for field cutting and fitting.

D. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.

E. Verification Samples: Submit representative samples of each material that is to be exposed in completed work. Show full color ranges and finish variations expected. Provide samples having minimum size of 144 sq. in.

F. Calculations: Provide professionally prepared calculations and certification of performance of this work. Indicate how design requirements for loading and other performance criteria have been satisfied; refer to Article 1.4, para. D for further description.

G. Test Reports: Provide certified test reports for specified tests.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Store under cover and protect from weather damage.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 WARRANTIES

A. Provide written warranty, signed by manufacturer, agreeing to repair or replace work that exhibits defects in materials or workmanship. "Defects" is defined to include, but not be limited to, leakage of water, abnormal aging or deterioration, abnormal

deterioration or fading of finishes, and failure to perform as required. Include requirement for removal and replacement of covering and connected adjacent work.

1. Warranty Period: Three (3) years from date of Substantial Completion; except finish shall be warranted for a period of fifteen (15) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCTS

A. Provide storefronts and entrance systems of one of the following manufacturers that meet or exceed requirements of these specifications:

1. Kawneer North America.
2. Oldcastle Building Envelope.
3. Wausau Metals Corporation.
4. YKK AP America, Inc.

B. Products:

1. Exterior frame system shall be equal to "1600 Wall System 1" curtain wall as manufactured by Kawneer, or approved equal by one of the manufacturers listed above.
2. Doors for exterior application shall be "Insulpour 250T Narrow Stile" manufactured by Kawneer, or approved equal manufacturer listed above.
3. Interior frame system shall be equal to "Trifab VersaGlaze 450" framing system, 2" sightline, as manufactured by Kawneer, or approved equal by one of the manufacturers listed above.
4. Doors for interior application shall be "190 Narrow Stile" manufactured by Kawneer, or approved equal by one of the manufacturers listed above.

2.2 MATERIALS AND ACCESSORIES

A. Aluminum Members: Provide 6063-T5 alloy and temper as recommended by manufacturer for strength, corrosion resistance, and application of required finish. Comply with ASTM B 221 for extrusions, and ASTM B 209 for sheet/plate. Provide 0.125" thick extrusions for door stiles and storefront framing. Provide 0.050" thick aluminum for glazing moldings.

B. Fasteners: Provide non-magnetic stainless steel fasteners, warranted by manufacturer to be non-corrosive and compatible with aluminum components.

C. Concealed Flashing: Dead-soft stainless steel, 26 gauge minimum, or extruded aluminum 0.062" minimum, of an alloy and type selected by manufacturer for compatibility with other components.

D. Brackets and Reinforcements: Non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A 123.

E. Concrete/Masonry Inserts: Cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 123.

F. Bituminous Coatings: Cold-applied asphalt mastic compounded for 30-mil thickness per coat.

G. Compression Weatherstripping: Manufacturer's standard replaceable stripping of molded neoprene or PVC gaskets complying with ASTM D 2287.

H. Sliding Weatherstripping: Manufacturer's standard replaceable stripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing.

2.3 HARDWARE

A. Provide hardware units as indicated, scheduled, or required for operation of each door. Refer to Section 087100, Finish Hardware for hardware description.

2.4 FABRICATION

A. Sizes and Profiles: Required sizes for door and frame units, including profile requirements, are indicated on Drawings. Any variable dimensions are indicated, together with maximum and minimum dimensions required to achieve design requirements and coordination with other work.

B. Prefabrication: To greatest extent possible, complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.

1. Preglaze door and frame units to greatest extent possible, in coordination with installation and hardware requirements.

2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.

3. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work in manner which prevents damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.

C. Welding: Comply with recommendations of American Welding Society to avoid discoloration; grind exposed welds smooth and restore mechanical finish.

D. Reinforcing: Install reinforcing as necessary for performance requirements; separate dissimilar metals with bituminous paint or other separator to prevent corrosion.

E. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

F. Fasteners: Conceal fasteners.

G. Provide EPDM/vinyl blade gasket weatherstripping in bottom exterior door rail, adjustable for contact with threshold.

H. At interior doors and other locations without weatherstripping, provide neoprene silencers on stops to prevent metal-to-metal contact.

I. Provisions shall be made in the framing for minimum edge clearance, nominal edge cover, and nominal pocket width for the thickness and type of glazing installed, and shall be in accordance with the FGMA Glazing Manual.

J. Pocket glazed framing shall provide:

	Single Glass	Insulating Glass
1. Nominal edge cover (or bite) framing only	5/16"	1/2"
2. Min. nominal edge clearance	1/8"	1/4"
3. Min. face clearance	1/8"	5/32"

2.5 STOREFRONT FRAMING

A. General: Provide inside-outside matched resilient flush glazed system with provisions for glass replacement. Shop fabricate and preassemble frame components where possible.

B. Thermal-Break Construction: Fabricate exterior aluminum storefront framing system with integrally concealed, low conductance thermal barrier, located between exterior materials and exposed interior members, in manner which eliminates direct metal-to-metal contact. Provide manufacturer's standard construction which has been in use for similar projects for at least three years.

C. For glass and glazing, refer to Section 088000.

2.6 ALUMINUM DOORS

A. Aluminum entrance doors shall be thermally-broken, narrow-stile, factory-glazed aluminum doors manufactured by same manufacturer as storefront framing.

B. Aluminum entrance doors shall be stile and rail type swing doors. Aluminum shall be extruded aluminum conforming to ASTM B 221, 0.125" thick for door stiles and 0.050" thick for glazing molding.

1. Sections shall be of sizes and profiles indicated; shall present straight, sharply defined lines and arrises; and shall be free from defects impairing strength, durability, and appearance.

2. Fasteners where exposed shall be aluminum or stainless steel Series 300.

C. Each door shall be factory glazed set in neoprene glazing gasket, refer to Section 088000 for glass.

D. Doors shall meet the following resistance to corner racking when tested by the Dual Moment Load Test.

1. Test section shall consist of a standard top door corner assembly. Side rail section shall be 24" long and top rail section shall be 12" long.

2. Anchor top rail positively to test bench so that corner protrudes 3" beyond bench edge.

3. Anchor a lever arm positively to side rail at a point 19" from inside edge of top rail. Attach weight support pad at a point 19" from inner edge of side rail.

4. Test section shall withstand a load of 235 lbs. on the lever arm before reaching the point of failure, which shall be considered a rotation of the lever arm in excess of 45 deg.

E. For door hardware, refer to Section 087100.

F. Door bottom rail of exterior doors shall have an EPDM blade gasket sweep strip applied with concealed fasteners.

G. Corner construction shall consist of mechanical clip fastening, SIGMA deep penetration and fillet welds. Glazing stops shall be hook-in type with EPDM glazing gaskets.

H. The door weatherstripping on a single-acting, offset-pivot or butt-hung exterior door and frame (single or pairs) shall be thermoplastic elastomer weatherstripping of a tubular shape with a semi-rigid polymeric backing.

I. The door weatherstripping on a double-acting, center-pivoted door and frame (single or pairs) shall be pile cloth. The door bottom rail shall be weatherstripped with an EPDM blade gasket sweep strip applied with concealed fasteners.

J. The meeting stiles on pairs of doors shall be equipped with an adjustable astragal.

2.7 FINISH

A. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer’s written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

2. Custom color and gloss as selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where aluminum entrances and storefronts are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install aluminum entrance doors and storefront framing in openings prepared under other Sections plumb, square, level, in exact alignment with surrounding work, with proper clearances, and securely and positively anchored to building structure, to meet performance requirements specified herein, in accordance with manufacturer's published instructions and approved submittals.

B. Use only skilled mechanics for erection, under supervision of manufacturer's representative.

C. Provide protection against galvanic action. Isolate dissimilar materials with bituminous coating or non-absorptive dielectric tape.

D. Install aluminum entrance doors, storefront frame, and finish hardware. Carefully fit and adjust doors and hardware to frames and weatherstripping. After erection check and adjust operating hardware for smooth and proper operation.

E. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated. Comply with requirements of Section 079200.

F. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances.

1. Variation from Plane: Limit variation from plane or location shown to 1/8" in 12 feet; 1/4" over total length.

2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16". Where surfaces meet at corners, limit offset from true alignment to 1/32".

3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8".

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent testing agency to perform testing indicated for storefronts.

B. Test fixed frames for water infiltration per AAMA 501.2; latest edition. Test within the first 10% of work complete, area to be a minimum of 100 SF of wall and including a perimeter where frames adjoin adjacent construction. Interior finishes must not interfere with observation of test area or be removed from test area. Not appropriate for operable doors.

1. This test (AAMA 501.2) shall be performed in the field on new construction.

C. Repair or remove Work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.4 PROTECTION AND CLEANING

A. Protect finished metal surfaces from damage during fabrication, shipping, storage, and erection, and from then until acceptance by Owner.

B. Clean metal surfaces promptly after installation, exercising care to avoid damage. Remove excess sealant, dirt, and other substances. Lubricate hardware and other moving parts.

C. Replace glass that is broken, cracked, or chipped prior to time of final acceptance of Project by Owner.

D. Clean glass surfaces promptly after installation, exercising care to avoid damage to same.

END OF SECTION

SECTION 084226

ALL-GLASS DOORS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the all-glass doors, as shown on the drawings, and/or specified herein, as needed for a complete and proper installation, including the following:

1. Clear, tempered glass doors.
2. Top center pivot hinge plate, stainless steel.
3. Top plate for mounting of electric lock clad in stainless steel.
4. 1" diameter push/pull bars.
5. Cylinder lock in bottom rail.
6. Recessed floor closer, center pivots, and extruded aluminum saddle with removable section at closer.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified glazing contractor certified under the NorthAmerican Contractor Certification Program (NACC)for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program OR a glazing contractor that can provide the following:

1). Five (5) years of glazing co. ownership and experience
2). Written references to demonstrate evidence of successfully completed similar projects
3). A formal Safety Program documented in writing
4). A formal Quality Manual documented in writing
5). Resume and qualifications for a Quality Manager
6). Evidence of a fully implemented Quality Management System, including installation quality verification metrics to be utilized on the project.

1.4 PERFORMANCE REQUIREMENTS

A. Provide systems, including anchorage, capable of withstanding loads indicated without structural failure, deflection exceeding specified limit, support components transferring

stresses to glazing, and glazing-to-glazing or glazing-to-support contact as determined by structural analysis.

1. Structural Loads:

   a. Wind Load: ___ psf positive and ___ psf negative.

2. Seismic Performance: All-glass entrances shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

3. Deflection Normal to Glazing Plane: Limited to 1/175 of clear span or 3/4", whichever is smaller.

B. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Product Data: For each type of product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Shop Drawings: Show details of fabrication and installation, including the following:

1. Plans, elevations, and sections.

2. Details of fittings.

3. Hardware quantities, locations, and installation requirements.

4. Anchorages and reinforcement.

5. Glazing details.

C. Samples for Verification: Of size indicated below and of same thickness and material indicated for Work. Show the full range of color and texture variations expected.

1. Metal Finishes: 6-inch long sections of patch fittings, rails, and other items.

2. Glass: 6 inches square showing exposed-edge finish.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify opening dimensions of all-glass entrances by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Submit a written warranty executed by the manufacturer agreeing to repair or replace components of all-glass entrances that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures.

2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

3. Failure of operating components to function normally.

B. Warranty Period: 2 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide all glass doors manufactured by Blumcraft of Pittsburgh, C.R. Laurence Co., Inc., Virginia Glass Products Corp., Oldcastle Building Envelope, or approved equal.

2.2 MATERIALS

A. Clear Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Class 1 (clear) requirements. Provide products of thickness indicated that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to CPSC 16 CFR, Part 1201 for Category II materials.

1. Thickness: 3/4 inch.

2. Exposed Edges: Flat polished.

3. Corner Edges: Mitered.

B. Stainless Steel: ASTM A 666, Type 302 or Type 304; No. 4 finish.

2.3 COMPONENTS

A. Fittings: Provide fittings and accessories for all-glass entrances of configurations shown on drawings fabricated of stainless steel, minimum 12 ga.

B. Anchors and Fastenings: Manufacturer's standard concealed anchors and fastening.

C. Weather Stripping: Manufacturer's standard sweep-type weather stripping.

2.4 HARDWARE

A. General: Heavy-duty hardware units indicated in sizes, numbers, and type recommended by manufacturer for all-glass entrances indicated. For exposed parts, match fitting metal and finish.

B. Closers: Center-hung, concealed floor closers complying with ANSI/BHMA A156.4, Grade 1 or Grade 2 requirements, including cases, bottom arms, top pivots, plates and accessories required for a complete installation, and as follows:

1. Swing: Single acting.

2. Hold Open: Selective.

3. Positive Dead Stop: Coordinated with hold-open angle.

4. Delayed-Action Closing: Comply with requirements of authorities having jurisdiction of the Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," whichever are more stringent.

a. Opening Force: 5 lbf.

C. Push/Pull: 1" diameter stainless steel, as shown on drawings.

D. Lockset: Bottom rail dead bolt, dead bolt operated by key outside and inside engaging cutout in threshold or floor plate.

1. Lock cylinder furnished by Section 087100.

E. Make provisions for and coordinate with installation requirements for electro/magnetic lock and door release at door head as specified in Section 087100.

F. Threshold: Manufacturer's standard threshold with cutouts coordinated for operating hardware, with anchors and jamb clips. not more than 1/2 inch high with beveled edges providing a floor-level change with a slope of not more than 1:2, and fabricated of stainless steel.

2.5 FABRICATION

A. General: Fabricate all-glass entrance components in sizes, profiles, and configurations indicated.

1. Provide holes and cutouts in glass to receive hardware, fittings, rails, and accessories before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

2. Fully temper glass using horizontal roller hearth process.

3. Factory assemble components and factory install hardware to greatest extent possible.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where all glass doors are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install all-glass entrances and associated components according to manufacturer's written instructions; coordinate installation with structural glass wall fabricator.

B. Set units level and plumb.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts according to manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required by hardware and substrate.

3.3 ADJUSTING AND CLEANING

A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer that ensure all-glass entrances are without damage or deterioration.

END OF SECTION

SECTION 08 44 18 - GLAZED STEEL CURTAIN WALL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fire-rated curtain wall systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of curtain wall framing.

B. Related Sections include the following:
1. Section 05 12 00 “Structural Steel Framing:” Steel attachment members
2. Section 05 50 00 “Metal Fabrications:” Steel attachment members inserts and anchors
3. Section 07 62 00 “Sheet Metal Flashing and Trim” Flashing between this work and other work
4. Section 07 84 00 – “Firestopping” for perimeter fire-containment systems (safing insulation) field installed with steel fire-rated glazed curtain-wall systems.
5. Section 07 92 00 – “Joint Sealants” for installation of joint sealants installed with steel fire-rated glazed curtain-wall systems and for sealants to the extent not specified in this Section.
6. Section 08 11 00 – “Metal Doors and Frames” for fire-rated doors.
7. Section 08 41 13 – “Aluminum Entrance and Storefronts”
8. Section 08 71 00 – “Door Hardware” for door hardware not provided by this Section.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA)
1. AAMA 501.1-2005: Standard Test Method for Water Penetration of Windows, Curtain Walls, and Doors Using Dynamic Pressure
2. AAMA 501.2-2003: Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems
3. AAMA 501.4-2000 (Revised 2001): Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts
4. AAMA 501.5-2005: Test Method for Thermal Cycling of Exterior Walls
5. AAMA 506-2000 (Revised 2003): Voluntary Specifications for Hurricane Impact and Cycle Testing of Fenestration Products
6. AAMA 1503-1998: Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
7. AAMA 2603-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
8. AAMA 2604-2005 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
9. AAMA 2605-2005 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

B. American Society for Testing and Materials (ASTM):
1. Fire safety related:
   a. ASTM E119: Methods for Fire Tests of Building Construction and Materials.
2. Material related
   a. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2007.

b. ASTM A 1011/A 1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2006b.

3. Exterior related
   a. ASTM E 283-04: Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
   b. ASTM E 330-02: Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference Procedure A
   c. ASTM E 331-04: Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
   d. ASTM E 783-02: Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors
   e. ASTM E 1105-00: Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference
4. Hurricane related
   a. ASTM E 1886-05: Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
   b. ASTM E 1996-05: Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
5. Sound related:
   a. ASTM E 90-04: Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
   b. ASTM E 413-04: Standard Classification for Rating Sound Insulation

C. American Welding Society (AWS)
1. AWS D1.3 - Structural Welding Code - Sheet Steel; 2007

D. Builders Hardware Manufacturers Association, Inc
1. BHMA A156 - American National Standards for door hardware; 2006 (ANSI/BHMA A156).

E. Canadian Standards
1. CAN/ULC-S101 Standard Test of Fire Endurance Tests of Building Construction and Materials
2. CAN/ULC-S104 Standard Method of Fire Tests of Door Assemblies
3. CAN/ULC-S106 Standard Method of Fire Tests of Window and Glass Block Assemblies

F. National Fire Protection Association (NFPA):
1. NFPA 80: Fire Doors and Windows.
2. NFPA 251: Fire Tests of Building Construction & Materials
3. NFPA 252: Fire Tests of Door Assemblies
4. NFPA 257: Fire Test of Window Assemblies

G. Underwriters Laboratories, Inc. (UL):
1. UL 9: Fire Tests of Window Assemblies
2. UL 10 B: Fire Tests of Door Assemblies
3. UL 10 C: Positive Pressure Fire Tests of Window & Door Assemblies
4. UL 263: Fire tests of Building Construction and Materials
5. UL-752: Ratings of Bullet-Resistant Materials

H. American National Standards Institute (ANSI):
1. ANSI Z97.1: Standard for Safety Glazing Materials Used in Buildings

I. Consumer Product Safety Commission (CPSC):

1. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials

J. American Society of Civil Engineers (ASCE)
1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures; 2005

1.3 DEFINITIONS

A. Manufacturer: A firm that produces primary glass, fabricated glass or framing as defined in referenced glazing publications.

1.4 SUBMITTALS

A. Submit in accordance with Section 013300

B. Product Data:
1. Technical Information: Submit latest edition of manufacturer's product data providing product descriptions, technical data, Underwriters Laboratories, Inc. listings and installation instructions.

C. Shop Drawings:
1. Include plans, elevations and details of product showing component dimensions; framed opening requirements, dimensions, tolerances, and attachment to structure

D. Sustainable Requirements:
1. Living Building Challenge Compliance: Compliant
1) I-13 Red List Declaration

E. Structural Calculations (optional):
1. Provide structural calculations sealed by a licensed professional engineer in the State in which the project is located; prepared in compliance with referenced documents and these specifications.

F. Samples. For following products:
1. Glass sample-as provided by manufacturer
2. Sample of frame
3. Verification of sample of selected finish

G. Glazing Schedule: Use same designations indicated on drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

H. Warranties: Submit manufacturer's warranty.

I. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements.
1. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualifications according to

1. International Accreditation Service for a Type A Third-Party Inspection Body (Field Services ICC-ES Third-Party Inspections Standard Operating Procedures, 00-BL-S0400 and S0401)
2. International Accreditation Service for Testing Body-Building Materials and Systems
    a. Fire Testing
        1) ASTM Standard E119
        2) CPSC Standard 16 CFR 1201
        3) NFPA Standards 251, 252, 257
        4) UL Standards 9, 10B, 10C, 1784, UL Subject 63
        5) BS 476; Part 22: 1987
        6) EN 1634-1
        7) CAN/ULC Standards S101, S104, S106

B. Environmental Qualifications
    1. Living Building Challenge Compliant and Red List Approved
        a. Declare label (#AGN-0010)
        b. https://declare.living-future.org/products/technical-glass-products-fireframes-curtainwall-series and can be used for building projects seeking to achieve either the Living Building Challenge or LEED green building rating systems.

C. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

D. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

E. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.

F. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are classified and labeled by UL, for fire ratings indicated, based on testing according to NFPA 257 and UL 9.

G. Fire-Rated Wall Assemblies: Assemblies complying with ASTM E119 that are classified and labeled by UL, for fire ratings indicated, based on testing in accordance with UL 263, ASTM E119.

H. Listing and Labels – Fire-Rated Assemblies: Under current follow-up service by Underwriters Laboratories® maintaining a current listing or certification. Label assemblies accordance with limits of manufacturer's listing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle under provisions specified by manufacturer.

1.7 PROJECT CONDITIONS

A. Obtain field measurements prior to fabrication of frame units. If field measurements will not be available in a timely manner, coordinate planned measurements with the work of other sections.
    1. Note whether field or planned dimensions were used in the creation of the shop drawings

B. Coordinate the work of this sections with others effected including but not limited to: other interior and /or exterior envelope components and door hardware beyond that provided by this section.

1.8 WARRANTY

A. Provide the Pilkington Pyrostop® and the Fireframes® Curtainwall Series standard five-year manufacturer warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. As basis of design or approved equal

B. Manufacturer Glazing Material: "Pilkington Pyrostop®" fire-rated glazing as manufactured by the Pilkington Group and distributed by Technical Glass Products, 8107 Bracken Place SE, Snoqualmie, WA 98065 phone (800.426.0279) e-mail tgp.sales@allegion.com, web site http://www.fireglass.com.

C. Frame System: Fireframes® Curtainwall Series fire-rated steel frame system as supplied by Technical Glass Products 8107 Bracken Place SE, Snoqualmie, WA 98065 phone (800.426.0279) e-mail tgp.sales@allegion.com, web site http://www.fireglass.com.

D. Substitutions: Substitutions for Glazing Material and Frame System not permitted.

2.2 PERFORMANCE REQUIREMENTS

A. System Description:
1. Steel fire-rated glazed curtain wall system, outside glazed pressure plate, cover cap format.
2. Face Widths Available:
   a. 1 3/4-inch.
   b. 2 3/8-inch wide.
3. Water Drainage:
4. System is vertically weeped. No joint plugs or weep holes at horizontal mullions. Horizontal gaskets are notched and received by vertical gaskets.

B. Structural Performance
1. Design and size the system to withstand structural forces placed upon it without damage or permanent set when tested in accordance with ASTM E330 using load 1.5 times the design wind loads and of 10 seconds in duration.
2. Positive wind load: as indicated on the drawings
3. Negative wind Load: as indicated on the drawings
4. Member deflection: Limit deflection of the edge of the glass normal to the plane of the glass to [flexure limit of glass][1/175 of the glass edge length or ¾ inch, whichever is less][of any framing member
5. Accommodate movement between storefront and adjoining systems

C. Air Infiltration: ASTM E 283; Air infiltration rate shall not exceed 0.06 cfm/ft^2 at a static air pressure differential of 6.24 psf.

D. Water Resistance, (static): ASTM E 331; No leakage at a static air pressure differential of 15 psf as defined in AAMA 501.

E. Water Resistance, (dynamic): AAMA 501.1; No leakage at an air pressure differential of 15 psf as defined in AAMA 501.

F. Thermal Movements: Provide steel fire-rated glazed curtain-wall systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 MATERIALS - GLASS

A. Low-E Coated glass for use in insulated exterior units See Section 08 80 00. See chart below for Low-E configurations.

B. Use the paragraph above to specify the low-e coated glass in Section 08 80 00 and use the paragraph below to select glass available from Technical Glass Products. Other manufacturer's glass will need to be shipped to Technical Glass Products for incorporation into insulated unit.

C. Not all Low-E coated glass by all manufacturers is available for assembly by others into insulated units. Consult with low-e glass manufacturer about availability of their low-e product for shipment to Technical Glass Products for inclusion into insulated units.

D. Fire Rated Glazing: Composed of multiple sheets of Pilkington "Optiwhite™" high visible light transmission glass laminated with an intumescent interlayer.

E. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).

F. Adjust list of thicknesses below to suit Project -- these are listed in tabular form delete those columns not used.

G. Properties Interior Glazing

Property				
Fire Rating	45 minute	60 minute		120 minute
Manufacturer's designation	45-200	60-101	60-201	120-104
Glazing type	single	single	single	IGU
Nominal Thickness	3/4" (19mm)	7/8" (23mm)	1-1/16" (27mm)	2-1/8 (54mm) [with 8 mm spacer, or 2-3/8" (60 mm) with 14 mm spacer]
Weight in lbs/sf	9.2	10.85	12.5	21.7
Daylight Transmission	86%	87%	86%	75%
Sound Transmission Coefficient	40dB	41dB	44dB	46dB

H. Properties Exterior Glazing

Property	45 minute	60 minute	120 minute

Manufacturer's designation	45-200	45-260 45-360	60-201	60-261 60-361*	120-262 120-362*
Glazing type	single	IGU	single	IGU	IGU
Nominal Thickness	3/4" (19mm)	1-5/16" (33mm)	1-1/16" (27mm)	1-5/8" (41mm)	2-3/8" (60mm) [with 14 mm spacer, or 2-1/8" (54 mm) with 8 mm spacer]
Weight in lbs/sf	9.2	12.5	12.5	15.8	22.1
Daylight Transmission	86	77	86%	77%	74%
		59-71		59-70%	33-68%
Sound Transmission Coefficient	40dB	40dB	44dB	44dB	46dB

* Low-E product.

I. Exterior Grade: PVB inner layer installed toward exterior.

J. Logo: Each piece of fire-rated glazing shall be labeled with a permanent logo including name of product, manufacturer, testing laboratory (UL), fire rating period, safety glazing standards, and date of manufacture.

K. Glazing Accessories: Manufacturer's standard compression gaskets, spacers, setting blocks and other accessories necessary for a complete installation.

2.4 MATERIALS –STEEL FRAMING

A. Steel Curtainwall Framing System 120 min
1. Frame: [Steel]: profiled steel tubing permanently joined with steel bolts.
2. Insulation: Insulate framing system against effects of fire, smoke, and heat transfer from either side. Firmly pack perimeter of framing system to rough opening with mineral wool fire stop insulation or appropriately rated intumescent sealant
3. Fasteners: Type recommended by manufacturer
4. Glazing Gaskets, Compounds and tapes: Glaze Pilkington Pyrostop glass with approved EPDM glazing gaskets and [closed cell PVC tape], or [pure silicone sealant].
5. Steel Pressure Plates: Formed stainless steel pressure plate with dimensions recommended by manufacturer to securely hold glazing material in place.
6. Cover Caps: Formed [steel] [stainless steel] [extruded aluminum].

B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).

C. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M Standard Specification for Carbon Structural Steel
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable

3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

D. Brackets and Reinforcements: Manufacturer's standard high-strength materials with nonstaining, nonferrous shims for aligning system components.

E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
4. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
5. Reinforce members as required to receive fastener threads.

F. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

G. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

2.5 ACCESSORIES

A. Exposed Fasteners: Use fasteners fabricated from Type 304 or Type 316 stainless steel.

B. Glazing Gaskets:
1. Glazing gaskets for interior or exterior applications: ASTM C 864 (extruded EPDM rubber that provides for silicone adhesion) or ASTM C1115 Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories (extruded silicone).

C. Intumescent Tape: As supplied by frame manufacturer.

D. Setting Blocks: ¼” Calcium silicate.

E. Perimeter Anchors: Steel or 316 Stainless steel when exposed.

F. Flashings: As recommended by manufacturer; same material and finish as cover caps.

G. Silicone Sealant: One-Part Low Modulus, neutral cure High Movement-Capable Sealant: Type S; Grade NS; Class 25 with additional movement capability of 100 percent in extension and 50 percent in compression (total 150 percent); Use (Exposure) NT; Uses (Substrates) M, G, A, and O as applicable. (Use-O joint substrates include: Metal factory-coated with a high-performance coating; galvanized steel; ceramic tile.)
1. Available Products:
a. Dow Corning 790, 795 - Dow Corning Corp.
b. Momentive
c. Tremco

H. Intumescent Caulk: Single component, latex-based, intumescent caulk designed to stop passage of fire, smoke, and fumes through fire-rated separations; permanently flexible after cure; will not support mold growth; flame spread/smoke developed 10/10.
1. Available Products:
a. 3M CP-25 WP+.

2.6 SLAG-WOOL-FIBER/ROCK-WOOL-FIBER INSULATION

A. Available Manufacturers:
1. Fibrex Insulations Inc.
2. Owens Corning
3. Thermafiber
4. Rockwool

B. Unfaced, Slag-Wool-Fiber/Rock-Wool-Fiber Board Insulation: ASTM C 612, maximum flame-spread and smoke-developed indexes of 15 and 0, respectively; passing ASTM E 136 for combustion characteristics; and of the following nominal density and thermal resistivity:
1. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
2. Fiber Color: Regular color, unless otherwise indicated.

2.7 FABRICATION

A. General:
1. Fabricate components per manufacturer's installation instructions and with minimum clearances and shim spacing around perimeter of assembly yet enabling installation and dynamic movement of perimeter seal.
2. Accurately fit and secure joints and corners. Make joints flush and weatherproof.
3. Prepare components to receive anchor devices.
4. Provide physical and thermal isolation of glazing from framing members.
5. Provide internal guttering to drain water from joints and condensation occurring within glazing pocket.
6. Fabricate anchors.
7. Arrange fasteners and attachments to be concealed from view.

B. Guttered System Components:
1. Fabricate components to resist water penetration as follows:
a. Internal guttering system or other means to drain water passing joints, occurring within framing members, and moisture migrating within glazed steel curtain walls.
b. Pressure-equalized system, double barrier, or two lines of air and water resistance design with primary air and water barrier at interior side of glazing pocket.

2.8 POWDER COAT FINISHES

A. Finish after fabrication.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

C. Interior and Exterior Steel Finishes (Note: this finish is suitable for exterior exposed portions of the wall systems, including extruded aluminum covers).
1. Powder-Coat Finish: Polyester Super Durable powder coating which meets AAMA 2604 for chalking and fading. Apply manufacturer's standard powder coating finish system applied to factory-assembled frames before shipping, complying with manufacturer's recommended instructions for surface preparation including pretreatment, application, and minimum dry film thickness.
2. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].
3. Acceptable Manufacturers:

a. Tiger Drylac
b. Additional manufacturers as approved by TGP

2.9 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

D. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.

E. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
   1. Color: As selected by Architect from full range of industry colors and color densities

F. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA [**2604**] [**2605**] and with coating and resin manufacturers' written instructions.

G. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from manufacturer's full range

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer’s instructions. Verify openings are sized to receive curtain wall system and sill plate is level in accordance with manufacturer’s acceptable tolerances.

B. Notify Architect of any conditions which jeopardize the integrity of the proposed fire wall / door system.

C. Do not proceed until such conditions are corrected.

3.2 INSTALLATION

A. See Fireframes Curtainwall Series Installation Manual

3.3 PROTECTION AND CLEANING

A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from the glass. Do not apply markers to the glass surface. Remove nonpermanent labels, and clean surfaces.
   1. Do not clean with astringent cleaners. Use a clean “grit free” cloth and a small amount of mild soap and water or mild detergent.
   2. Do not use any of the following:
      a. Steam jets
      b. Abrasives
      c. Strong acidic or alkaline detergents, or surface-reactive agents
      d. Detergents not recommended in writing by the manufacturer
      e. Do not use any detergent above 77 degrees F
      f. Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.
      g. Metal or hard parts of cleaning equipment must not touch the glass surface

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 08900

Section 08 45 00 Translucent Wall and Roof Assemblies

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes requirements for translucent wall and roof assemblies.

1.2 WORK INCLUDED

A. Engineer, manufacture, and installation of translucent wall and/or roof assemblies.
B. All anchors, brackets, hardware and all flashing up to but not penetrating adjoining work are also required as part of the system and shall be included.
C. Trained and factory authorized labor and supervision to complete the installation.

1.3 RELATED WORK ELSEWHERE

A. Structural Steel/Wood Framing/Concrete, Section __ 051200_____
B. Curbs and supporting members, Section _____N/A_____
C. Roofing, Section _____ 075323_____
D. Sheet Metal and Flashing, Section ____ 076200_____
E. Sealant, Section _____079200_____

1.4 QUALITY ASSURANCE

A. Products shall be manufactured by a company continuously and regularly employed in the engineering and manufacturing of translucent wall and roof assemblies for a period of at least ten (10) years.
B. Product manufacturer shall be ISO-9001 accredited
C. Erection shall be by a factory-approved installer who has been in the business of erecting similar material for at least five (5) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope, and type.
D. The manufacturer shall be responsible for the configuration and fabrication of the complete translucent system in accordance with this specification.

1.5 SUBMITTALS

A. Submit color samples of colors specified or the manufacturers standard range.
B. Submit Shop drawings indicating dimensions, tolerances, profiles, connections, drainage, flashing, color selections, and coordination with adjacent scope.
C. The manufacturer shall submit substantiating data, stating that the products to be furnished are in accordance with or exceed these specifications.
D. The manufacturer shall submit full warranty terms and conditions for verification of compliance with the requirements of this specification.
E. The manufacturer shall submit performance data based on the following standards:
    1. Self-Ignition Temperature (ASTM D 1929)
    2. Burning Extent (ASTM D 635)

3. Smoke Density or Development (ASTM E 84, UL 723, or ASTM D 2843)
4. Interior Flame Spread Index (ASTM E 84)
5. ICC Evaluation Service Report (ICC-ESR)
6. Insulation U-factor (NFRC 100)
7. Solar Heat Gain Coefficient (SHGC) (NFRC 201)
8. Visible Transmittance (VT) (NFRC 202)
9. Condensation Resistance (NFRC 500)
10. Air Infiltration (ASTM E 283)
11. Water Penetration (ASTM E 331)
12. Load Bearing Ability (ASTM E 330)

1.6 MAINTENANCE DATA

A. The manufacturer shall provide recommended maintenance procedures, schedule of maintenance and materials required or recommended for maintenance.

1.7 WARRANTY

A. Submit manufacturer's written warranty agreeing to repair failures in materials and workmanship that lead to leaking into the building within ten (10) years from date of delivery.
B. Provide a ten (10) warranty on the glazing covering change in light transmission of no more than 6% per ASTM D-1003.
C. Metal Finish Warranty:
    1. CLEAR Anodize: Provide manufacturer's standard 5 year
D. Submit installer's written warranty agreeing to repair installation workmanship, defects and leaks within one year from date of delivery.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Basis of design
    1. The design and performance criteria of this job are based on
        a. 3" UniQuad®
B. Or Approved Equal

2.2 TRANSLUCENT WALL AND ROOF ASSEMBLY DESCRIPTION AND PERFORMANCE

A. Description: Translucent glazing assemblies
    1. A factory assembled double-glazed panel assembly incorporated into a complete aluminum frame system tested and warranted by the manufacturer as a single source system. Overall glazing assembly thickness shall be a minimum 2.75".
    2. Design shall provide for the replacement of the exterior glazing, independently of the interior glazing without exposing the building's interior or compromising

the weather tightness of interfering with the normal working functions of the building. Single layer glazing systems are not acceptable.

3. Translucent polycarbonate glazing must be constructed of tight cell sizes not exceeding 0.18". Wider cells shall not be acceptable.
4. Glazing must be manufactured with a permanent integral ultra-violet protective layer.

B. Flammability
   1. Interior Glazing Sheet:
      a. Self-Ignition Temperature per ASTM D 1929: 950°F
      b. Smoke Development Index per ASTM E 84: 62.7
      c. Burning Rate per ASTM D 635: ZERO
   2. Exterior Glazing Sheet:
      a. Self-Ignition Temperature per ASTM D 1929: 950F°
      b. Smoke Development Index per ASTM E 84: 62.7
      c. Burning Rate per ASTM D 635: ZERO
   3. Currently Listed ICC-ES Report confirming compliance with IBC Chapter 26: ESR-4745 - ICC Evaluation Service, LLC (ICC-ES)

C. Air, Water, Structural, and Impact
   1. Air Permeability for each product per ASTM E 283:
      a. 3" UniQuad: .04 CFM/SF @ 1.57 PSF
   2. No water leakage for each product per ASTM E 331:
      a. 3" UniQuad: 6.24 PSF
   3. Proof wind loading per ASTM E 330/TAS 202:
      a. 3" UniQuad: up to +40/-60PSF design load

D. Energy Performance
   1. Product must be currently listed and certified by the NFRC as required in Section R303.1.3 of the IECC; listed products receive an identifying CPD#
      a. Basis of Design CPD#:
         i. 3" UniQuad
   2. Exterior glazing color:
      a. Ice White
   3. Interior glazing color:
      a. Ice White
   4. NFRC Certified System Performance Values
      a. U-factor per NFRC 100: ___.36 U VAUE OR BETTER_____
      b. Solar heat gain per NFRC 201: ____STD_____
      c. Visible Transmittance per NFRC 202: _____STD_____
      d. Condensation Resistance per NFRC 500: ____STD_____
   5. Panel and perimeter framing to be thermally broken

E. Sound Transmission or Outside/Inside Transmission Coefficient per ASTM E90: _____24_____STC, ____17_____OITC or better

2.3 METAL FRAME STRUCTURE

A. Design criteria shall be per ASCE-7 requirements
B. Aluminum structural profiles shall be limited to a deflection of L/120 IBC Table 1604.3.
C. panel and perimeter framing to be thermally broken

2.4 METAL MATERIALS

A. Extruded aluminum shall be ANSI/ASTM B-221; 6063-T5/T6, 6005-T5 or 6061-T5/T6
B. Flashing: 5005 H34 Aluminum .040" thick
C. All fasteners for aluminum framing to be stainless steel or cadmium plated steel
D. All exposed Aluminum shall be finished:
    1. Anodized finish as per performance requirement
        a. [215 Class I Clear Anodized]

PART 3 – EXECUTION

3.1 EXAMINATION

A. The installer shall examine the area of installation to verify readiness of site conditions. Do not work until conditions are satisfactory.

3.2 INSTALLATION

A. Install components in strict accordance with manufacturer's instructions on approved shop drawings.

END OF SECTION

SECTION 084513

STRUCTURED POLYCARBONATE PANEL ASSEMBLIES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the structured polycarbonate panel assemblies as indicated on the drawings and/or specified herein including, but not limited to, the following:

1. Flat, factory-prefabricated, structural insulated translucent sandwich panels.
2. Aluminum installation system
3. Aluminum sill flashing

1.3 RELATED SECTIONS

A. Structural Steel - 051200.

B. Carpentry - Section 062000.

C. Joint Sealers - Section 079200.

D. Aluminum Entrances and Storefronts - Section 084113.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, profiles and finishes of components, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of work. Provide plans, elevations, dimensions, and details of anchorages, connections and accessory items. Provide installation templates for work installed by others. Show interfaces and relationships to work of other trades.

C. Field Measurements: Take necessary field measurements before preparation of shop drawings and fabrication. Do not delay progress of job. If field measurements are not possible prior to fabrication, allow for field cutting and fitting.

D. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.

E. Verification Samples: Submit representative samples of each material that is to be exposed in completed work. Show full color ranges and finish variations expected. Provide samples following minimum sizes:

1. Sandwich Panels: 14" x 28" units.

2. Factory-Finished Aluminum: 5" long sections.

F. Structural Analysis Data/Calculations: Provide professionally prepared data, calculations and certification of performance of this work by a licensed engineer in the State of New Jersey. Indicate how design requirements for loading and other performance criteria have been satisfied.

G. Test Reports: Provide certified test reports for specified tests.

H. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.

I. Submit product test reports from a qualified independent testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.

1. Test reports required are:

a. Self-Ignition Temperature (ASTM D 1929).
b. Smoke Density (ASTM D 2843).
c. Burning Extent (ASTM D 635).
d. Interior Flame Spread (ASTM E 84).
e. Color Difference (ASTM D-2244).
f. Tests on a weathered system after approximately10 years of actual exposure in Florida field conditions. Tests shall include:
   1). Uniform static air pressure per ASTM 330.
   2). Impact loading per ASTM E 695.
   3). Cyclic static air pressure and missile impact level D per ASTM E 1886 and ASTM E 1996.
g. Weathering Evaluation before and after exposure to 300 deg F, 25 minutes include Light Transmission and Color Change, per ASTM E 1175, and ASTM D 2244 respectively.
h. Large Missile Test - Impact Resistance per SFBC PA 201-94.
i. Impact loading per ASTM E 695.
j. Insulation's 'U' value for Center of Glazing per NFRC100.
k. Insulation's 'U' value for wall-light system, glazing and aluminum framing, per NFRC 100 and NFRC 700 certification.
l. Visible Light Transmission (VT): Per ASTM E 972 and ASTM E 1084.
m. Solar Heat Gain Coefficient (SHGC): Based on tests or calculations which are based on tests per methodology and procedure given in the NFRC/Calorimeter Standard.
n. Maximum air infiltration rate for fenestration assemblies of curtain walls, per NFRC 400 or ASTM E 283.
o. Water Penetration (ASTM E 331).
p. Load Bearing Capability (ASTM E 330-97).

q. Performance of exterior windows, curtain walls per ASTM E 1886 and ASTM E 1996-02, Level D.
r. Haze per ASTM D 1003 for glare measurement.
s. ICC evaluation service report for compliance with IBC building code for polycarbonate glazing as an approved light transmission plastic with CC1 rating per chapter 26, and class A interior finish glazing per chapter 8.
t. Sound Transmission Loss (STC of 26) per ASTM E413

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten (10) consecutive years and which can show evidence of those materials being satisfactorily used on at least six (6) projects of similar size, scope and location. At least three (3) of the projects shall have been in successful use for ten (10) years or longer.

2. Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.

3. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.

B. Installer’s Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified panel systems for at least two (2) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

C. A single installer shall have responsibility for providing and installing metal panels, CPI panels, windows, and AC sleeves.

D. Performance Requirements: The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.

1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 PERFORMANCE REQUIREMENTS

A. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.

1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Standard panel system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 psf (50 mph) and no water penetration by ASTM E 331 at 15 psf; and structural testing by ASTM E 330.

3. Structural Loads: Provide system capable of handling a wind load of 30 psf.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver panel system, components and materials in manufacturer's standard protective packaging.

B. Store panels on the long edge; several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.8 WARRANTY

A. Provide a single source Wall Light system manufacturer warranty against defective materials and fabrication. Submit manufacturer's written warranty agreeing to repair Wall Light system work, which fails in materials within one year from date of delivery.

B. Provide single source Wall Light's manufacturer 10-year glazing panel warranty. Third party warranty for glazing panels shall not be acceptable. Glazing warranty to include:

1. Change in light transmission of no more than 6% per ASTM D 1003.

2. No delamination of panel affecting appearance, performance or structural integrity of the panel or the system.

3. Thermal Aging: The light transmission and the color shall not change after exposure to heat of 300 deg F for 25 minutes (when measured per ASTM D 1003 and ASTM D 2244 respectively).

C. In addition, submit installer's written warranty agreeing to repair installation workmanship, defects and leaks within one year from date of delivery.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis of Design: Kingspan Light + Air, Inc.; UniQuad - Unitized Translucent Wall System.

B. Other Acceptable Manufacturers: Approved equal by Extech Exterior Technologies, Inc., Wasco Skylights, or approved equal.

2.2 TRANSLUCENT PANEL PERFORMANCE AND APPEARANCE

A. Panel Construction for Longevity and Resistant to Buckling and Pressure:

1. Translucent panels must be constructed of tight cell sizes not exceeding 0.18". Wide cell size exceeding 0.18" shall not be acceptable.

2. The translucent panel shall include an integral extruded tight-cell structural core. The panel's exterior skins shall be connected with supporting continuous ribs,

perpendicular to the skins, at a spacing not to exceed 0.18" (truss-like construction). In addition, the space between the two exterior skins shall be divided by multiple parallel horizontal surfaces, at a spacing not to exceed 0.18".

B. Translucent Wall Panel – Unitized Quad Glazed

1. Design, engineer, manufacture and installation of two panels insulated translucent wall-light system. An assembly of two independent insulated single glazing polycarbonate multi-cell panels in one integrated daylighting panel assembly, incorporated into a complete aluminum framed system that has been tested and warranted by the manufacturer as a single source system. Design shall provide for the replacement of the exterior panel using tools, independently of the interior single panel and without exposing the interior or compromising the weather tightness or interfering with the normal working functions of the building. The interior single insulated panel remains intact for the life of the building envelope. Single panel extruded polycarbonate cellular or fiberglass sandwich panel systems will not meet these requirements and are not acceptable.

2. Panel glazing assembly thickness shall be a [4" two panel system with concealed interlocking connector/ H battens]. Minimum thickness of the exterior and the interior single panels shall be 0.315" thick each.

3. Panel Width: Not to exceed 2'-0" to ensure best performance for wind uplift, vibration, oil canning and visual appearance. Panels over 2'-0" wide will not be approved.

C. Thermal and Solar Performance:

1. Insulation 'U' Value performance per NFRC100 and 700, is required by the IBC/IECC/ASHRE energy code. Such performance values must be certified and labeled by NFRC.

2. U value for standard panel assembly with no bat or aerogel insulation, Center of Glazing per NFRC100: 0.23.

3. U value for panel system assembly with no bat or aerogel insulation and including wall-light aluminum framing per NFRC100 and NFRC700: 0.26 for anodize frame.

4. Visible Light Transmission: Center of Glass (V.T. 25%) per ASTM E 972 and ASTM E 1084.

5. Solar Heat Gain Coefficient (SHGC): 0____ independently tested or calculated based on testing per methods and procedures given in the NFRC Calorimeter.

D. Translucent Panel Joint System:

1. Panel shall be extruded in one single formable length. Transverse connections are not acceptable.

2. The panels should be manufactured with grip-lock double tooth upstands that are integral to the unit. The upstands shall be 90 degrees to the panel face (standing seam dry glazed concept). Welding or gluing of upstands or standing seam is not acceptable.

3. The H battens shall have a grip-lock double tooth locking mechanism to ensure maximum uplift capability.

4. The panel joint connection shall comply with the deflection limitation of IBC Table 1604.3 for exterior walls with flexible finishes - span/120 per ASTM E 330.

5. The metal retention clip shall be configured with a 0.4" wide top flange that extends continuously across the web from end to end and from side to side. To allow safety factor, the clip must be tested to meet a wind uplift standard of 90 PSF per ASTM E 330.

6. Water Penetration: No water penetration of the panel H joint connection length at test pressure of 6.24 PSF per ASTM E 331.

7. Free movement of the panels shall be allowed to occur without damage to the weather tightness of the completed system

E. Flammability:

1. The exterior and interior panels shall be an approved light transmitting panel with a CC1 fire rating classification per ASTM D 635. Flame spread no greater than 25 per ASTM E 84. Smoke density no greater than 75 per ASTM D 2843 and a minimum self-ignition temperature of 1000 deg F per ASTM D 1929.

2. Interior flame spread classification of Class A per ASTM E 84.

F. Impact Resistance: The panels shall pass the following tests:

1. SFBC – PA 201-94, impact resistance of 350 ft. lbs.

2. ASTM E 695 - Impact loading per - 500 ft. lbs.

3. ASTM E 1996-02 - Must comply with standard specification for performance of exterior windows or curtain walls when impacted by windborne debris at level D and after cyclic wind loading at the specified design load.

G. Cyclic Wind Load: Translucent panels shall be tested for cyclic wind loads and impact resistance per ASTM E 1886 and ASTM E 1996 at test load to verify the positive and negative design loads and level D impact.

H. Weatherability:

1. The light transmission shall not decrease more than 6% as measured by ASTM D 1003 over 10 years, or after exposure to temperature of 300 deg F for 25 minutes (thermal aging performance standard).

2. The weathering performance should be justified by successful testing of the glazing panel's performance after exposure to actual Florida weather conditions for approximately 10 years in comparison to a new panel assembly. This performance must be demonstrated by providing independent lab test reports for the exposed and a new panel assembly of Quadwall with 10mm exterior, 6' wide x 12' long for:

a. Uniform static air pressure per ASTM 330 at negative load of -105 psf and positive load of 130 psf.

b. Impact loading per ASTM E 695 of 500 ft-lb.
c. Cyclic static air pressure at 65 PSF and impact level D per ASTM 1886 and ASTM E 1996.
d. Test results must show that there is no deterioration in performance for the 10 year's exposed panels versus a new panel.

3. Panels must be manufactured from polycarbonate resin with a permanent, co-extruded ultra-violet protective layer. Post-applied coatings or films of dissimilar materials are unacceptable.

4. The faces shall not become readily detached when exposed to temperatures of 300°F and 0°F for 25 minutes.

5. Thermal Aging: The interior and exterior panel shall not change color in excess of 0.75 Delta E per ASTM D 2244 and shall not darken more than 0.3 units Delta L per ASTM D 2244 and shall show no cracking or crazing when exposed to 300 deg F for 25 minutes.

6. Panel shall be factory sealed at the sill to restrict dirt ingress.

I. Glare and Diffused Light Transmission: To avoid glare per IECC requirements, the panels shall have a matte finish with a minimum Haze measurement of 90% per ASTM D 1003.

J. Sound Transmission Class (STC) Rating: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent agency.

1. Sound Transmission Class (STC): Paired-panel assemblies shall have a minimum overall acoustic value of the following STC:

a. Paired-Panel Assembly; 4 Inches (101mm) Thick: STC 26.

K. Exterior Graphic at Polycarbonate Panels: Provide 3M exterior wall graphic as noted on the elevation drawings.

2.3 METAL FRAME STRUCTURE

A. Design criteria shall be ASCE-7.

B. The wall light framing is designed to be self-supporting between the support constructions. The deflection of the structural framing members in a direction normal to the plane of the glazing, when subjected to a uniform load deflection, shall not exceed L/120 for the unsupported span per IBC 2012 table 1604.3. The wall lights will impose reactions to the support construction. All adjacent and support construction must support the transfer of all loads including horizontal and vertical, exerted by the wall lights. Design or structural engineering services for the supporting structure or building components is not included in the wall light scope of this section.

C. Water Penetration: The metal framed wall light panels shall allow no water penetration at a minimum differential static pressure of 6.24 lbs. per sq. ft per AAMA 501 pressure difference recommendations and as demonstrated by prior testing of typical framing sample per ASTM E 331.

D. Water test of metal frame structure shall be conducted according to procedures in AAMA 501.2.

E. Maximum air infiltration rate for fenestration of the two panel assemblies of wall light shall be per NFRC 400.

2.4 METAL MATERIALS

A. Extruded Aluminum shall be ANSI/ASTM B 221; 6063-T6: 6063-T5 or 6005-T5.

B. Flashing:

1. 5005 H34 aluminum.

2. Sheet metal flashings/closures/claddings are to be furnished shop formed to profile when lengths exceed 10 ft. in nominal 10-ft lengths. Field trimming of the flashing and field forming the ends is necessary to suit as-built conditions. Sheet metal ends are to overlap at least 6" to 8", set in a full bed of sealant, and riveted if required.

C. All fasteners for aluminum framing to be stainless steel or cadmium plated steel, excluding the final fasteners to the building.

D. All exposed aluminum finish Clear Anodized Class I, with 5-year warranty.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, supporting structure and installation conditions. Do not proceed with panel erection until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install the panel system in accordance with the manufacturer's installation recommendations and approved shop drawings.

1. Anchor component parts securely in place by permanent mechanical attachment system.

2. Accommodate thermal and mechanical movements.

3. Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.

B. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturer's installation instructions.

3.3 CLEANING

A. Clean the panel system inside and outside, immediately after installation, according to manufacturer's written recommendations.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
2. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
3. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
4. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:

a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
c. Indicate complete designations of each item required for each opening, include:
    1) Door Index: door number, heading number, and Architect's hardware set number.
    2) Quantity, type, style, function, size, and finish of each hardware item.
    3) Name and manufacturer of each item.
    4) Fastenings and other pertinent information.
    5) Location of each hardware set cross-referenced to indications on Drawings.
    6) Explanation of all abbreviations, symbols, and codes contained in schedule.
    7) Mounting locations for hardware.
    8) Door and frame sizes and materials.
    9) Degree of door swing and handing.
    10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
    a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
    b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
    f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
    a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
    b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
    a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
    b. Catalog pages for each product.
    c. Final approved hardware schedule edited to reflect conditions as installed.
    d. Final keying schedule

e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105

b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for key control system.
      4) Requirements for access control.
      5) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) Schlage L Series: 10 years
        2) Exit Devices
            a) Von Duprin: 10 years
        3) Closers
            a) LCN 4050 Series: 25 years
    b. Electrical Warranty
        1) Closers
            a) LCN: 2 years

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

2. Acceptable Manufacturers and Products:

a. No Substitute
b. Hager BB1191/1279 series
c. Stanley FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives
2. Acceptable Manufacturers:
   a. No Substitute
   b. Select
   c. ABH

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.

4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. No Substitute
   b. Burns
   c. Trimco

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage L9000 series

2. Acceptable Manufacturers and Products:
   a. No Substitute
   b. Falcon MA series
   c. Corbin-Russwin ML2000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.

5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches. Provide motor based electrified and motor based latch retraction locksets that comply with the following requirements:
    a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
    b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
    c. Low maximum current draw – maximum 0.4 amps (Lever control) and maximum 2.0 amps (Latch retraction) to allow for multiple locks on a single power supply.
    d. Low holding current (Lever control or latch retraction) – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications and motorized latch retraction applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
    e. Connections – provide quick-connect Molex system standard.

8. (OPTION Key Override) Provide locks with a key override feature built into the chassis that allows the outside key to retract the deadbolt and/or latchbolt, overriding the inside thumbturn when it is being held in the locked position - where the XL13-439 option is specified in the hardware sets.
9. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
    a. (OPTION Vandlgard) Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
    b. Lever Design: 06A.

2.07 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
    a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:
    a. No Substitute
    b. Precision APEX 2000 series
    c. Falcon 24/25 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.

6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.08 CYLINDERS

A. Manufacturers:

1. Coordinate with Ownership to determine the key system and cylinder requirements prior to the ordering of any hardware.

B. Requirements:

1. Provide cylinders/cores to match Owner’s existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer’s series as indicated. Refer to “KEYING” article, herein.

2.09 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Telkee

2. Acceptable Manufacturers:
   a. No Substitute
   b. HPC
   c. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
   a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.

b. Provide hinged-panel type cabinet for wall mounting.

2.10 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4050A series

2. Acceptable Manufacturers and Products:
   a. No Substitute
   b. Falcon SC70A series
   c. Norton 7500 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.11 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. No Substitute
   b. Burns
   c. Trimco

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.12 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. No Substitute
   b. Burns
   c. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.13 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. No Substitute
   b. Sargent
   c. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.14 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. No Substitute
   b. Burns
   c. Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.

4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.15 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers:
   a. No Substitute
   b. National Guard
   c. Reese

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.16 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. No Substitute
   b. Burns
   c. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.17 MAGNETIC HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. LCN

2. Acceptable Manufacturers:
   a. No Substitute
   b. Rixson
   c. Sargent

B. Requirements:

1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.18 COAT HOOKS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. No Substitute
   b. Burns
   c. Trimco

B. Provide coat hooks as specified.

2.19 FINISHES

A. FINISH: BHMA 619/646 (US15); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Door Closers: Powder Coat to Match
4. Latch Protectors: BHMA 630 (US32D)
5. Weatherstripping: Clear Anodized Aluminum
6. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Abbreviation	Name
ACC	Accurate Lock & Hardware Co
DON	Don-Jo Manufacturing, Inc.
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
LCN	LCN Commercial Division
MIS	Misc - Out-Sourced Items
PEM	Pemko Mfg Co
SCH	Schlage Lock Company
TGP	Technical Glass Products
VON	Von Duprin
ZER	Zero International Inc

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HARDWARE GROUP NO. 01

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD (HEIGHT PER SCHED)		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	PANIC HARDWARE	CDSI-35A-EO		619	VON
1	EA	PANIC HARDWARE	CDSI-35A-NL-OP-388		619	VON
3	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	RIM CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	90 DEG OFFSET PULL	8190EZHD 10" STD		BLK	IVE
2	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
2	EA	CUSH SHOE SUPPORT	4050A-30 SRT		689	LCN
2	EA	BLADE STOP SPACER	4050A-61 SRT		689	LCN
2	EA	DOOR SWEEP	328AA (WIDTH PER SCHEDULE)		AA	ZER
1	EA	MULLION SEAL	870NBK (HEIGHT PER SCHED)		BK	ZER
1	EA	PILE MEETING SEAL	BY ALUM DOOR MANUFACTURER		GRY	
1	EA	PILE PERIMETER SEAL	BY ALUM DOOR MANUFACTURER		GRY	
1	EA	THRESHOLD	PER DETAIL			

HARDWARE GROUP NO. 01-SEC

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112HD EPT (HEIGHT PER SCHED)	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-35A-EO-CON	619	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-35A-NL-OP-388-CON 24 VDC	619	VON
2	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM	619	
1	EA	90 DEG OFFSET PULL	8190EZHD 10" STD	BLK	IVE
2	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
2	EA	CUSH SHOE SUPPORT	4050A-30 SRT	689	LCN
2	EA	BLADE STOP SPACER	4050A-61 SRT	689	LCN
2	EA	DOOR SWEEP	328AA (WIDTH PER SCHEDULE)	AA	ZER
1	EA	MULLION SEAL	870NBK (HEIGHT PER SCHED)	BK	ZER
1	EA	PILE MEETING SEAL	BY ALUM DOOR MANUFACTURER	GRY	
1	EA	PILE PERIMETER SEAL	BY ALUM DOOR MANUFACTURER	GRY	
1	EA	THRESHOLD	PER DETAIL		
2	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR		SCH
2	EA	WIRE HARNESS	CON-6W TO POWER		SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER		
1	EA	POWER SUPPLY	BY SECURITY		
1	EA	CARD READER	BY SECURITY		
2	EA	DOOR CONTACTS	BY SECURITY		

HARDWARE GROUP NO. 01.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	FIRE EXIT HARDWARE	98-EO W/CYL HOLE-F-990	619	VON
1	EA	RIM CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM	619	
1	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	619	IVE
1	EA	DOOR SWEEP	328AA (WIDTH PER SCHEDULE)	AA	ZER
1	SET	GASKETING	429AA (THREE SIDES OF THE FRAME)	AA	ZER
1	EA	THRESHOLD	PER DETAIL		

HARDWARE GROUP NO. 01.2 - Not Used

HARDWARE GROUP NO. 01.3

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	SET	PIVOT	BY DOOR MANUFACTURER			TGP
2	EA	POWER TRANSFER	BY DOOR MANUFACTURER			TGP
2	EA	ELEC FIRE EXIT HARDWARE	RX-LC-3547A-L-F-06		619	VON
2	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
2	EA	PA FLUSH PANEL ADAPTER	4040XP-419 SRT		689	LCN
1	SET	GASKETING	BY TGP MANUFACTURER		BLK	TGP

HARDWARE GROUP NO. 01.4-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD EPT (HEIGHT PER SCHED)		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-QEL-35A-NL-OP-F-L/TRIM-388-CON 24 VDC		619	VON
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	90 DEG OFFSET PULL	8190EZHD 10" STD		BLK	IVE
1	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
1	EA	CUSH SHOE SUPPORT	4050A-30 SRT		689	LCN
1	EA	BLADE STOP SPACER	4050A-61 SRT		689	LCN
1	EA	DOOR SWEEP	328AA (WIDTH PER SCHEDULE)		AA	ZER
1	EA	PILE PERIMETER SEAL	BY ALUM DOOR MANUFACTURER		GRY	
1	EA	PILE PERIMETER SEAL	BY ALUM DOOR MANUFACTURER		GRY	
1	EA	THRESHOLD	PER DETAIL			
1	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
1	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 01.5-SEC

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP		646	IVE
2	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8		619	IVE
1	EA	FIRE RATED REMOVABLE MULLION	KR9954		689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-QEL-98-EO-F 24 VDC		619	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-QEL-98-NL-OP-F-110MD 24 VDC		619	VON
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	RIM CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
2	EA	90 DEG OFFSET PULL	8190EZHD 10" STD		BLK	IVE
2	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		619	IVE
2	EA	DOOR SWEEP	328AA (WIDTH PER SCHEDULE)		AA	ZER
1	EA	GASKETING	488SBK (THREE SIDES OF THE FRAME)		BK	ZER
1	EA	MULLION SEAL	870NBK (HEIGHT PER SCHED)		BK	ZER
2	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
2	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
2	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 01.6

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5		646	IVE
2	EA	FIRE EXIT HARDWARE	9849-L-BE-F-06		619	VON
2	EA	SURFACE CLOSER	4050A EDA		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		619	IVE
2	EA	MAGNET	SEM7830 12V/24V/120V		689	LCN
1	EA	GASKETING	488SBK (THREE SIDES OF THE FRAME)		BK	ZER
1	EA	ASTRAGAL	S771		BLK	PEM

HARDWARE GROUP NO. 01.7

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5		646	IVE
2	EA	FIRE EXIT HARDWARE	9849-L-BE-F-06		619	VON
2	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		619	IVE
1	EA	GASKETING	488SBK (THREE SIDES OF THE FRAME)		BK	ZER
1	EA	ASTRAGAL	S771		BLK	PEM

HARDWARE GROUP NO. 01.8-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		646	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8		619	IVE
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-98-NL-OP-110MD-CON 24 VDC		619	VON
1	EA	RIM CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	90 DEG OFFSET PULL	8190EZHD 10" STD		BLK	IVE
1	EA	SURFACE CLOSER	4050A EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
1	EA	WALL STOP	WS406/407CCV		619	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
1	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 01.9

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		646	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
2	EA	ELEC FIRE EXIT HARDWARE	RX-LC-9827-L-F-2SI-LBRAFL-06-499F		619	VON
2	EA	RIM CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM @ DEVICES		619	
2	EA	RIM CYL THUMBTURN, ADA	XB13-379		619	SCH
2	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		619	IVE
1	EA	GASKETING	488SBK (THREE SIDES OF THE FRAME)		BK	ZER
1	EA	ASTRAGAL	S771		BLK	PEM
2	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
2	EA	WIRE HARNESS	CON-6W TO POWER			SCH
2	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 01.10

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5		646	IVE
1	EA	FIRE EXIT HARDWARE	9827-L-BE-F-LBR-06-499F		619	VON
1	EA	FIRE EXIT HARDWARE	9827-L-BE-F-LBRAFL-06-499F		619	VON
2	EA	SURFACE CLOSER	4050A EDA		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		619	IVE
2	EA	WALL STOP	WS406/407CCV		619	IVE
2	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 01.11-SEC

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		619	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-98-EO-CON 24 VDC		619	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-98-NL-OP-110MD-CON 24 VDC		619	VON
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM @ MULLION		619	
2	EA	RIM CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM @ DEVICES		619	
2	EA	90 DEG OFFSET PULL	8190EZHD 10" STD		BLK	IVE
2	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		619	IVE
1	EA	MULLION SEAL	870NBK (HEIGHT PER SCHED)		BK	ZER
2	EA	SILENCER	SR64		GRY	IVE
2	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
2	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 01.12-SEC

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT (HEIGHT PER SCHED)		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-35A-EO-CON 24 VDC		619	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-35A-NL-OP-388-CON 24 VDC		619	VON
2	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
2	EA	90 DEG OFFSET PULL	8190EZHD 10" STD		BLK	IVE
2	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
2	EA	CUSH SHOE SUPPORT	4050A-30 SRT		689	LCN
2	EA	BLADE STOP SPACER	4050A-61 SRT		689	LCN
1	EA	MULLION SEAL	870NBK (HEIGHT PER SCHED)		BK	ZER
1	EA	PILE MEETING SEAL	BY ALUM DOOR MANUFACTURER		GRY	
1	EA	PILE PERIMETER SEAL	BY ALUM DOOR MANUFACTURER		GRY	
2	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
2	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	CARD READER	BY SECURITY			
2	EA	DOOR CONTACTS	BY SECURITY			
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC			VON

HARDWARE GROUP NO. 01.13-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		646	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-98-L-F-M996-06-FSE-CON		619	VON
1	EA	RIM CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
1	EA	GASKETING	488SBK (THREE SIDES OF THE FRAME)		BK	ZER
1	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
1	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 02

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ALL HARDWARE	BY ROLL-UP FIRE SHUTTER		

HARDWARE GROUP NO. 03

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		619	IVE
1	EA	CLASSROOM DEAD LOCK	L463L (W/ INSIDE THUMB)		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	PUSH PLATE	8200 4" X 16" CFC		619	IVE
1	EA	PULL PLATE	8303 8" 4" X 16" CFT		619	IVE
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
1	EA	WALL STOP	WS406/407CCV		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 03.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 06A 09-544 OS-OCC		619	SCH
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
1	EA	WALL STOP	WS406/407CCV		619	IVE
1	EA	COAT AND HAT HOOK	571		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 03.3

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD (HEIGHT PER SCHED)		628	IVE
3	EA	HINGE FILLER PLATE	HEIGHT WIDTH AND WEIGHT TO SUIT		600	DON
1	EA	CLASSROOM DEAD LOCK	L463L (W/ INSIDE THUMB)		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	PUSH PLATE	8200 4" X 16" CFC		619	IVE
1	EA	PULL PLATE	8303 8" 4" X 16" CFT		619	IVE
1	EA	OH STOP	90S (SIZE PER SCHED)		619	GLY
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	MOUNTING PLATE	4050A-18 SRT		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 04

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
2	EA	MANUAL FLUSH BOLT	FB358 (TOP & BOTT)		619	IVE
1	EA	DUST PROOF STRIKE	DP2		619	IVE
1	EA	OFFICE W/SIM RETRACT	L9056L 06A 09-544		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
2	EA	OH STOP	90S (SIZE PER SCHED) @ BOTH		619	GLY
1	EA	SURFACE CLOSER	4050A (REG) @ ACTIVE		689	LCN
1	EA	MOUNTING PLATE	4050A-18 SRT		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		619	IVE
2	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 04.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD (HEIGHT PER SCHED)		628	IVE
1	EA	NARROW STILE MORTISE LOCK	8748 X 06A SCH LEVER (LESS CYL)		619	ACC
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	WALL STOP	WS406/407CCV		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 04.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
1	EA	OFFICE W/SIM RETRACT	L9056L 06A 09-544		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	OH STOP	90S (SIZE PER SCHED)		619	GLY
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	MOUNTING PLATE	4050A-18 SRT		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 04.3

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
1	EA	OFFICE W/SIM RETRACT	L9056L 06A 09-544		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
1	EA	WALL STOP	WS406/407CCV		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 04.4

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD (HEIGHT PER SCHED)		628	IVE
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		619	IVE
3	EA	HINGE FILLER PLATE	HEIGHT WIDTH AND WEIGHT TO SUIT		600	DON
1	EA	OFFICE W/SIM RETRACT	L9056L 06A 09-544		619	SCH
1	EA	RIM CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 05-SEC

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
5	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8		619	IVE
2	EA	MANUAL FLUSH BOLT	FB358 (TOP & BOTT)		619	IVE
1	EA	DUST PROOF STRIKE	DP2		619	IVE
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
2	EA	OH STOP	90S (SIZE PER SCHED) @ BOTH		619	GLY
1	EA	SURFACE CLOSER	4050A (REG) @ ACTIVE		689	LCN
1	EA	MOUNTING PLATE	4050A-18 SRT @ ACTIVE		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		619	IVE
2	EA	SILENCER	SR64		GRY	IVE
2	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
2	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 05.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		619	IVE
1	EA	STOREROOM LOCK	L9080L 06A		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	OH STOP	100S (SIZE PER SCHED)		619	GLY
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 05.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		619	IVE
1	EA	STOREROOM LOCK	L9080L 06A		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 05.3

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		619	IVE
1	EA	STOREROOM LOCK	L9080L 06A		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
1	EA	WALL STOP	WS406/407CCV		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 05.4

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		619	IVE
2	EA	MANUAL FLUSH BOLT	FB358 (TOP & BOTT)		619	IVE
1	EA	DUST PROOF STRIKE	DP2		619	IVE
1	EA	STOREROOM LOCK	L9080L 06A		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	OH STOP	90S (SIZE PER SCHED) @ BOTH		619	GLY
1	EA	SURFACE CLOSER	4050A SCUSH @ ACTIVE		689	LCN
1	EA	MOUNTING PLATE	4050A-18 SRT		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		619	IVE
2	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 05.5-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8		619	IVE
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	OH STOP	90S (SIZE PER SCHED)		619	GLY
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	MOUNTING PLATE	4050A-18 SRT		689	LCN
1	EA	GASKETING	488SBK (THREE SIDES OF THE FRAME)		BK	ZER
1	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
1	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 05.6-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8		619	IVE
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
1	EA	WALL STOP	WS406/407CCV		619	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
1	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 05.7-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD (HEIGHT PER SCHED)		628	IVE
1	EA	NARROW STILE MORTISE LOCK (STORE)	8759 X 06A SCH LEVER (LESS CYL)		619	ACC
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	ELECTRIC STRIKE	6211AL FSE DSLC CON 12/16/24/28 VAC/VDC		630	VON
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	WALL STOP	WS406/407CCV		619	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 05.8-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		646	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8		619	IVE
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	SURFACE CLOSER	4050A SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
1	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 05.9-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8		619	IVE
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
1	EA	WALL STOP	WS406/407CCV		619	IVE
1	EA	GASKETING	488SBK (THREE SIDES OF THE FRAME)		BK	ZER
1	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
1	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 05.10-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8		619	IVE
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC		619	SCH
1	EA	LOCK PATCH FITTING	AS REQUIRED BY GLASS DOOR MANUFACTURER		619	MIS
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	OH STOP	90S (SIZE PER SCHED)		619	GLY
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	MOUNTING PLATE	4050A-18 SRT		689	LCN
1	SET	PERIMETER SEALS	BY ALUM DR MFG			MIS
1	EA	WIRE HARNESS	CON X LENGTH TO SUIT HWR			SCH
1	EA	WIRE HARNESS	CON-6W TO POWER			SCH
1	EA	WIRE DIAGRAM	BY HARDWARE SUPPLIER			
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

HARDWARE GROUP NO. 06

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		619	IVE
1	EA	CLASSROOM LOCK	L9070L 06A		619	SCH
1	EA	MORTISE CYLINDER	TIE INTO OWNER'S EXISTING KEY SYSTEM		619	
1	EA	SURFACE CLOSER	4050A (REG)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		619	IVE
1	EA	WALL STOP	WS406/407CCV		619	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE GROUP NO. 07-SEC

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	PIVOT	BY DOOR MANUFACTURER			TGP
1	EA	POWER TRANSFER	BY DOOR MANUFACTURER			TGP
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-35A-L-BE-F-E360-06-FSE 24 VDC		619	VON
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
1	EA	PA FLUSH PANEL ADAPTER	4040XP-419 SRT		689	LCN
1	SET	GASKETING	BY TGP MANUFACTURER		BLK	TGP
1	EA	POWER SUPPLY	BY SECURITY			
1	EA	CARD READER	BY SECURITY			
1	EA	DOOR CONTACTS	BY SECURITY			

OPERATIONAL DESCRIPTION:
1. DOOR NORMALLY CLOSED AND LOCKED.
2. ENTRY BY VALID CREDENTIAL AT CARD READER WHICH SIGNALS TRIM OF EXIT DEVICE TO OPEN AND ALLOW ENTRY.
3. FREE EGRESS AT ALL TIMES VIA THE PANIC DEVICE.
4. PANIC DEVICE HAS RX SWITCH WHICH WILL SIGNAL ACCESS CONTROL SYSTEM OF A VALID RELEASE.
5. TRIM IS FAIL-SECURE UPON LOSS OF POWER DOOR WILL REMAIN LOCKED.

END OF SECTION

Renovation & Addition Union College Physical Ed Center

Door Numbers	HwSet#
100	01-SEC
101	01
102	02
103	01.1
104	01
105	01-SEC
106	07-SEC
107	01.3
108	03
109	03
110	03.1
111	05.6-SEC
112	05.6-SEC
113	01.4-SEC
114	01
115	01.9
116	01.13-SEC
117	01.4-SEC
118	01
119	01-SEC
120	05-SEC
121	01.5-SEC
122	01.13-SEC
123	01.9
124	05.2
125	05.6-SEC
126	05-SEC
127	04
128	05.5-SEC
129	05.7-SEC
130	05.6-SEC
131	05.3
132	01.6
133	04.2
133	05.10-SEC
134	04.3
135	05.1
136	04.3
137	05.6-SEC
138	05.7-SEC
139	04.1
140	05.7-SEC
141	05.5-SEC
142	05.6-SEC
143	05.5-SEC
144	05.5-SEC

Door Numbers	HwSet#
145	05.6-SEC
146	05.6-SEC
147	05.1
148	05.1
149	05.1
150	05.1
151	01.6
152	01.7
153	02
154	01.12-SEC
155	03.3
200	03.1
201	03.1
202	03.1
203	03.1
204	01.10
205	06
206	05.8-SEC
207	05.9-SEC
208	01.6
209	05.6-SEC
210	05.6-SEC
211	05.8-SEC
212	05.2
213	03
214	03
216	05.4
217	05.4
218	01.8-SEC
219	05.4
220	01.8-SEC
221	05.2
222	01.11-SEC
223	05.4
224	05.4
225	05.4
226	01.11-SEC
227	04.4

SECTION 088000

GLASS AND GLAZING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the glass and glazing as shown on the drawings and/or specified herein, including, but not limited to, glazing of the following:

1. Windows.
2. Doors.
3. Entrances.
4. Storefront framing.
5. Interior borrowed lites.
6. Interior frameless mirrors.

1.3 RELATED SECTIONS

A. Steel Doors and Frames - Section 081113.

B. Aluminum Entrances and Storefronts - Section 084113.

C. Toilet Accessories - Section 102813, for framed bathroom mirrors.

1.4 REFERENCES

A. Comply with the recommendations of the following references unless more stringent requirements are indicated herein.

1. FGIA Publications: FGIA Glazing Manual.
2. LSGA Publications: LSGA Design Guide.
3. SIGMA Publications: TM-3000 Vertical Glazing Guidelines.
4. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201, Safety Standards for Architectural Glazing, Sealed Insulating Glass Manufacturing Association.

5. Fire-Resistive Glazing Products for Door Assemblies: Products identical to those tested per ASTM E 152, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

6. ASTM C 920, Standard Specification for Elastomeric Joint Sealants.

7. Insulating Glass Criteria: IGCC International Glass Certification Council.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated on drawings and/or specified herein are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

   a. Specified Design Wind Loads: Per ASCE-7.

2. Probability of Breakage for Vertical Glazing

   a. 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
   b. 1 lite per 1000 for lites installed 15 degrees from the vertical and under wind action.
   c. Load Duration: 60 seconds or less.

3. Maximum Lateral Deflection: For glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/100 times the short side length or 1/2", whichever is less.

4. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   a. Temperature Change (Range): 120 deg. F ambient; 180 deg F, material surfaces.

5. Thermal Solar Performance: See Article 2.2 herein.

C. Glass units shall be annealed, heat-strengthened, fully tempered or laminated where required to meet wind and/or snow loads and safety glazing requirements as shown,

specified or recommended by the glass fabricator and as required by the International Building Code/2021, NJ ed.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements, including performance requirements.

B. Submit compatibility and adhesion test reports from sealant manufacturer indicating materials were tested for compatibility and adhesion with glazing sealant, as well as other glazing materials including insulation units.

C. Initial Selection Samples: Submit samples of each glass and glazing material showing complete range of colors, textures, and finishes available for each material used.

1. Submit complete range of samples of standard colors and patterns for ceramic frits at insulating glass.

2. Submit complete range of samples of sandblasted glass showing variations of grits and opacity achieved.

D. Verification Samples: Submit representative samples of each glass and glazing material that is to be exposed in completed work. Show full color ranges and finish variations expected. Provide glass samples having minimum size of 144 sq. in. and 6 in. long samples of sealants and glazing materials; all samples shall bear the name of the manufacturer, brand name, thickness, and quality.

E. Calculations: Provide wind load charts, calculations, thermal stress analysis, and certification of performance of this work. Indicate how design requirements for loading and other performance criteria have been satisfied. Document shall be signed and sealed by a Professional Engineer licensed in the State of New Jersey.

F. Test Reports: Provide certified reports for specified tests.

G. Warranties: Provide written warranties as specified herein.

1.7 QUALITY ASSURANCE

A. Source: For each glass and glazing type required for work of this Section, provide primary materials which are products of one manufacturer. Provide secondary or accessory materials which are acceptable to manufacturers of primary materials.

B. Installer Qualifications: A qualified glazing contractorcertified under the NorthAmerican Contractor Certification Program (NACC)for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program OR a glazing contractor that can provide the following:

1). Five (5) years of glazing co. ownership and experience
2). Written references to demonstrate evidence of successfully completed similar projects
3). A formal Safety Program documented in writing

4). A formal Quality Manual documented in writing
5). Resume and qualifications for a Quality Manager
6). Evidence of a fully implemented Quality Management System, including installation quality verification metrics to be utilized on the project.

C. Glass Thickness: Glass thicknesses shown on drawings and/or specified herein are minimum thicknesses. Determine and provide size and thickness of glass products that are certified to meet or exceed performance requirements specified in this Section.

D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated.

1. GANA Publications: GANA's "Glazing Manual" and "Laminated Glass Design Guide."

2. IGMA Publications: IGMA TM-3000, "Vertical Glazing Guidelines for Sealed Insulating Glass Units."

E. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

F. Heat Strengthened, Tempered and Safety Glazing Products: Comply with the applicable requirements of the laws, codes, ordinances, and regulations of Federal and Municipal authorities having jurisdiction. Wherever requirements conflict, the more stringent shall be required. Obtain approvals from all such authorities. As a minimum provide Category II materials complying with testing requirements in 16 CFR Part 12 and ANSI Z97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council.

a. For glazing types with multiple lites of glass, laminated or assembled into an insulating unit, where safety labeling is required, provide labels that align in position and orientation from lite to lite.

2. Heat Strengthened, Tempered and Safety Glazing Labeling: Where heat strengthened, tempered and safety glazing are indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

3. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

G. Insulating Glass Certification Program: Permanently marked on spacers with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.

2. Associated Laboratories, Inc.

3. Insulating Glass Manufacturers Alliance.

H. Manufacturer shall be ISO 9001-2000 Certified.

1.8 TESTS

A. Preconstruction Sealant Test: Submit samples of materials to be used to glazing sealant manufacturer to determine sealant compatibility. Include samples of glass, gaskets, glazing materials, framing members, and other components and accessories of glazing work. Test in accordance with ASTM C 794 to verify what type of primers (if any) are required to ensure sealant adhesion to substrates.

1. Submit minimum of nine pieces of each type and finish of framing member, and nine pieces of each type, class, kind, condition, and form of glass, including monolithic, laminated, and insulating glass for adhesion tests.

2. Provide manufacturer's written report and recommendations regarding proper installation.

1.9 PROJECT CONDITIONS

A. Weather: Perform work of this Section only when existing or forecasted weather conditions are within limits established by manufacturers of materials and products used.

B. Temperature Limits: Install sealants only when temperatures are within limits recommended by sealant manufacturer, except, never install sealants when temperatures are below 40 deg. F.

C. Do not install sealants when substrates are wet or where contaminants capable of interfering with adhesion are present.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations and GANA Manual.

1. Protect materials from moisture, sunlight, excess heat, sparks and flame.

2. Sequence deliveries to avoid delays, but minimize on-site storage.

3. Glass shall be delivered to the site bearing the manufacturer's label, complete with glazing instructions where applicable.

4. Comply with insulating glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 WARRANTIES

A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

B. Manufacturer's Special Project Warranty on Coated Glass Products: Provide written warranty signed by manufacturer of coated glass agreeing to furnish f.o.b. point of manufacture, within specified warranty period indicated below, replacements for those coated glass units which develop manufacturing defects. Manufacturing defects are defined as peeling, cracking or deterioration in metallic coating due to normal conditions and not due to handling or installation or cleaning practices contrary to glass manufacturer's published instructions.

1. Warranty Period: Manufacturer's standard but not less than five (5) years after date of substantial completion.

C. Manufacturer's Special Project Warranty on Insulating Glass: Provide written warranty signed by manufacturer of insulating glass agreeing to furnish f.o.b. point of manufacture, freight allowed project site, within specified warranty period indicated below, replacements for those insulating glass units developing manufacturing defects. Manufacturing defects are defined as failure of the hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance; provided the manufacturer's instructions for handling, installing, protecting and maintaining units have been complied with during the warranty period.

1. Warranty Period: Manufacturer's standard but not less than ten (10) years after date of substantial completion.

D. Manufacturer’s Special Project Warranty on Laminated Glass: Manufacturer’s standard form, made out to Owner and signed by laminated glass manufacturer agreeing to replace laminated glass units that deteriorate as defined in “Definitions” Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty period five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/FABRICATORS

A. All glass and glazing used at the exterior of the Project shall be manufactured by the same manufacturer. The same manufacturer and the same furnace shall be used for all tempered and heat strengthened glass used throughout the project. Acceptable manufacturers include, but are not limited to, the following:

1. Vitro Architectural Glass.

2. Guardian Industries.

3. Pilkington.

4. Viracon.

5. Or approved equal.

2.2 GLASS MATERIALS AND PRODUCTS

A. Ultra-Clear (Low-Iron) Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.

1. Low Iron Tempered Glass: Provide "Starphire" by Vitro Architectural Glass, or approved equal, tempered in accordance ASTM C 1048, thicknesses as indicated.

B. Clear Float Glass: ASTM C 1036, Type I (transparent, flat), Class 1 (clear), Quality q3, minimum 1/4" thick.

C. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated), Type I (transparent, flat), Class 1 (clear) or Class 2 (Tinted), Quality q3, Kind FT, minimum 1/4" thick. Tempered glass must be certified by SGCC to meet applicable standards.

1. Performance Requirements for Tempered Glass

a. Length and Width: For 2.9 mm to 6.0 mm; +/-1.6 mm.
b. Diagonal: +/- 3.0 mm.
c. Edgework: Belt seaming or diamond wheels. 1.5 mm seam of upper and lower glass edges. No sharp edges.
d. Corners: No more than 3.0 mm from square.
e. Float Glass Defects: Must meet the requirements of ASTM C 1036. The most common defects are scratches, stones gaseous bubbles and edge chips. Tables in the glass standards have limits for size/quantity of defects.
f. Tempered glass shall have a minimum surface compression of 10,000 psi.
g. Tempered glass to be heat-treated by horizontal (roller hearth) process with inherent roller-wave distortion parallel to the bottom edge of the glass when installed.
h. Flatness Tolerances
1). Roller-Wave or Ripple: The deviation from flatness at any peak shall be targeted not exceed 0.003" as measured per peak to valley for ¼" (6mm) thick glass.
2). Bow and Warp: The bow and warp tolerances shall not exceed 1/32" per linear foot.
3). Fully tempered glass shall be heat soaked to EN 14179-1:2016-European Heat Soaking Standard.

D. Laminated Safety Glass: Provide two glass panes of equal thickness, laminated together with a polyvinyl butyl interlayer, conforming to ASTM C 1172 and as follows:

1. Interlayer Color: Clear.

2. Interlayer Material: Provide "Sentry Glass Plus" by DuPont, Kuraray America or approved equal, 0.030" thick at vertical applications, and 0.060" thick at sloped or horizontal applications. Use ionoplast-type (SGP) interlayer where laminated glass edges will be exposed to direct wetting or relative humidity (RH) conditions greater than 60%.

3. Minimum thickness of 1/4".

E. Patterned Glass: Provide ceramic frit patterned glass in custom colors and patterns as selected by the Architect, minimum thickness of 1/4". Ceramic frit glass shall meet requirements specified herein for ceramic frit spandrel glass.

F. Insulating Glass: Insulating glass unit shall consist of 1/4" clear exterior lite of float (or tempered, where required) glass with low-E coating on No. 2 face, 1/2" interspace and 1/4" clear interior lite of float (or tempered, where required) glass. Provide factory assembled units of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space, complying with ASTM E 2190, and as follows:

1. Sealing System: Dual seal.

2. Primary Sealant: Polyisobutylene.

3. Secondary Sealant: Silicone, General Electric IGS 3204 or IGS 3100, or Dow Corning 982.

   a. For structurally glazed IG units, secondary seal shall conform to ASTM C 1249.
   b. Primary and secondary seals shall not contain voids and must be continuously bonded to the glass structure.

4. Spacer: Clear finish aluminum with welded, soldered, or bent corners, hollow tube types, filled with low nitrogen absorption desiccant.

5. Desiccant: Molecular sieve, silica gel, or blend of both.

6. Interspace Content: Argon.

7. Air Space Thickness: 1/2".

8. Glass Thickness: 1/4" minimum.

9. Low-E Coating: Provide high-performance, clear, metallic coating, VE1-2M as manufactured by Viracon or approved equal. Provide low-E coating having the following performance characteristics when applied to the No. 2 surface of 1" insulating units, both lites 1/4" clear:

   a. Visible Light Transmittance: 70%.
   b. Solar Energy Transmittance: 33%.
   c. Solar Heat Gain Coefficient (SHGC): 0.38.
   d. U-Value: 0.29 winter, 0.26 summer.

10. Units shall be certified for compliance with seal classification "CBA" by the Insulating Glass Certification Council (IGCC) or by IGMA, and tested in accordance with the above ASTM Test Methods.

11. Insulating glass shall conform to the following tolerances:

    a. Length and Width: + 3.0 mm/ -2.0 mm.
    b. Diagonal: +/- 3.0 mm.
    c. Thickness: As agreed +/- 1.0 mm.

d. Edge-Deletion of Coating: Minimum 8 mm wide. Width of deletion must be more than the width of the secondary seal. Silver layer(s) must be completely removed. Appearance must be uniform.
e. Primary PIB Seal: Must be complete with no breaks. Appearance must be uniform. PIB bead must overlap coating. No visible bright line when glass is viewed in transmission. The width of the PIB bead shall be 4.0 mm + 3.0/ - 1.5 mm.
f. Secondary Seal: Nominal 6 mm + 3.0/ - 1.5 mm. The minimum width of the secondary silicone seal for IG units that are glazed structurally must be determined according to ASTM C 1249. The secondary seal must be uniformly applied without bubbles, cavities or gaps. Avoid excess sealant that will need to be trimmed off later.

12. Additional requirements and properties for primary and secondary insulating glass seals and spacers:

a. All glass units shall comply with IGMA Guidelines which limits the dimension of the visible edge seal encroachment into the vision area to be no greater than the sightline infringement of 3mm (0.12").
b. Insulating glass unit hermetic seal to consist of butyl primary and silicone secondary seals with bent, welded, or soldered interpane spacer corners; keyed corners are not acceptable unless also soldered or welded. Spacers shall be aluminum or stainless steel. Locate spacer joint at the top or sides of the units, but in no instances at the sill. Design units to minimize the number of spacer joints. Provide solid keys, embedded in butyl sealant on all four sides, at spacer joints.
c. Hermetic seals must be continuous and intimately bonded to both lites of glass. Provide primary seal of uniform depth with a nominal width of 1/8" to 3/16". Hermetic seals shall not be contaminated with debris, fingerprints, or other foreign matter and shall not contain voids or air pockets that decrease the width of the seal below the minimum widths listed in these Specifications, or that breach the seal. The width of the primary seal shall not be less than 1/16", and the total cumulative length of the primary seal between 1/16" and 1/8" shall be less than 12" in any one insulating glass unit. The primary seal shall not have a reduced thickness at the corners. An increased thickness of the primary seal at the corners is acceptable.
d. Provide secondary seal of uniform depth with a nominal width of ¼". Provide a total width of the primary and secondary seal of ½". Units shall meet IGMA 65-7-2, latest edition. Units shall not contain breather or capillary tubes or similar penetrations.

G. Ceramic Frit Spandrel Glass

1. Heat-treated glass with ceramic coating complying with ASTM C 1048, Condition B (spandrel glass, one surface ceramic-coated), Type 1 (transparent, flat), Quality Q3 (Glazing Select), with other requirements as specified.

2. GANA/GTA 66-9-20, Specification for Heat-Strengthened or Fully Tempered Ceramic Enamel Spandrel Glass Used for Building Window/Curtain Walls.

3. Custom color selected by the Architect.

H. Fire-Rated Glazing Material: Proprietary product in the form of clear flat sheets of 3/16" nominal thickness weighing 2.5 lb./sq. ft., and as follows:

1. Fire Protection Rating: As required by Code for the fire rated opening in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

2. Product: "Premium FireLite" by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products or approved equal.

I. Frameless Mirrors: 1/4", Quality q2, clear float glass with silver, copper, and organic coating, edges uniformly ground and polished.

1. At weight room and physical therapy room and as shown on the drawings provide and install HD Tempered safety backed mirrors.

2.3 GLAZING MATERIALS AND PRODUCTS

A. General: Provide sealants and gaskets with performance characteristics suitable for applications indicated. Ensure compatibility of glazing sealants with insulating glass sealants, with laminated glass interlayers, and with any other surfaces in contact.

B. General Glazing and Cap Bead Sealant: Provide sealant with maximum Shore A hardness of 50. Provide one of the following:

1. Dow Corning 795.

2. General Electric Silglaze N 2500 or Contractors SCS-1000.

3. Tremco Spectrem 2.

4. Or approved equal.

C. Weather Seal Sealant: Provide non-acid curing sealant with movement range $\pm$ 50%, ASTM C 719. Provide one of the following:

1. Dow Corning 795.

2. General Electric Silpruf.

3. Tremco Spectrem 2.

4. Or approved equal.

D. Backer Rod: Closed cell non-gassing polyethylene rod with rod diameter 25% wider than joint width.

E. Dense Elastomeric Compression Seal Gaskets: Provide molded or extruded neoprene or EPDM gaskets, Shore A hardness of 75$\pm$5 for hollow profile, and 60$\pm$5 for solid profiles, ASTM C 864.

F. Cellular, Elastomeric Preformed Gaskets: Provide extruded or molded closed cell, integral-skinned neoprene, Shore A 40$\pm$5, and 20% to 35% compression, ASTM C 509; Type II.

G. Preformed Glazing Tape: Provide solvent-free butyl-polyisobutylene rubber with 100% solids content complying with ASTM C 1281 AAMA A 800 with integral continuous EPDM shim. Provide preformed glazing tape in extruded tape form. Provide Tremco "Polyshim II" or approved equal.

H. Setting Blocks: Provide 100% silicone blocks with Shore A hardness of 80-90. Provide products certified by manufacturer to be compatible with silicone sealants. Length to be not less than 4". Width for setting blocks to be 1/16" more than glass thickness and high enough to provide the lite recommended by glass manufacturer. When thickness of setting block exceeds 3/4" the glass manufacturer must be consulted for sizes and configuration. In a vented system, setting block shall be designed so as to not restrict the flow of water within the glazing rabbet to the weep holes.

1. Shims: For shims used with setting blocks, provide same materials, hardness, length and width as setting blocks.

2. Structural Silicone Glazing: Provide silicone setting blocks where structural silicone occurs at sills and at insulating units with silicone edge seals.

I. Edge Blocks: Provide neoprene or silicone as required for compatibility with glazing sealants. Provide blocks with Shore A hardness of 55±5.

J. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place.

K. Miscellaneous Glazing Materials: Provide sealant backer rods, primers, cleaners, and sealers of type recommended by glass and sealant manufacturers.

L. Mirror Adhesive: Palmer's "Mirro-Mastic," or approved equal. Mastic must be compatible with mirror backing.

1. Clips: No. 4 finish Type 304 stainless steel.

2.4 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

C. Grind smooth and polish exposed glass edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine glazing framing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep system.

3. Minimum required face or edge clearances.

4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GENERAL GLAZING STANDARDS

A. Install products using the recommendations from the manufacturer of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in the GANA "Glazing Manual."

B. Verify that Insulating Glass Unit (IGU) secondary seal is compatible with glazing sealants.

C. Install glass in prepared glazing channels and other framing members.

D. Install setting blocks in rabbets as recommended by referenced glazing standards in GANA's "Glazing Manual" and IGMA's "Glazing Guidelines."

E. Provide bite on glass, minimum edge and face clearances and glazing material tolerances recommended by GANA's "Glazing Manual."

F. Provide weep system as recommended by GANA's "Glazing Manual."

G. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.

H. Distribute the weight of glass unit along the edge rather than the corner.

I. Comply with manufacturers and referenced industry standards on expansion joint and anchors; accommodating thermal movement; glass openings; use of setting blocks, edge, face, and bite clearances; use of glass spacers; edge blocks and installation of weep systems.

J. Protect glass edge damage during handling and installation.

K. Prevent glass from contact with contaminating substances that result from construction operations, such as weld spatter, fireproofing or plaster.

L. Remove and replace glass that is broken, chipped cracked or damaged in any way.

3.4 GLAZING

A. Glazing channel dimensions, as indicated on Shop Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead. Install setting blocks at the one greater points of each lite along the horizontal mullion.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

K. Flush Glazing

1. If the butt joint in the metal framing is in the vertical direction, the glazier shall run the tape initially on the head and sill members going directly over this joint. Should the butt joint in the metal framing run horizontally, tapes must first be applied to the jambs so that it crosses over the joint.

2. Each tape section shall butt the adjoining tape and be united with a tool to eliminate any opening.

3. Do not overlap the adjoining length of tape or rubber shim as this will prevent full contact around the perimeter of glass.

L. Off-Set Glazing

1. Where the glazing legs are off-set, the difference in the rabbet width shall be compensated by employing different glazing tapes with different diameter shims. The difference in shim shall be equal to the size of the off-set. The thinner tape shall be positioned first on the glazing leg closest to the interior. The thicker tape shall be cut to the exact length of the dimension between the applied tapes, and installed on the outermost glazing leg.

2. Immediately prior to setting glass, paper backing shall be removed. Apply a toe bead of sealant 6" in each direction, from each corner.

3. Locate setting blocks in the sill member at quarter points, or if necessary to within 6" of each corner. Setting blocks must be set equal distance from center line of the glass and high enough to provide the recommended bite and edge clearances.

4. Set edge block according to glass manufacturer's recommendations.

5. Set Glass: The glass shall be pressed firmly against the tape to achieve full contact.

6. In a vented system, apply a heel bead (air seal) of sealant around the perimeter of glass, between the sole of the I.G. unit and the base of the rabbet of the metal framing developing a positive bond to the unit and to the metal framing. The bead of the sealant shall be deep enough so that it will partially fill the channel to a depth of 1/4" between the glass edge and the base of the metal framing rabbet.

7. Interior stops shall be set, and glazing tape spline for the appropriate face clearance shall be rolled into place, compressing the glass to the shim within the glazing tape.

3.5 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant as recommended by glass manufacturer or glass frame manufacturer.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces

of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape where noted on approved shop drawings.

3.6 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.7 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

1. Exterior glazing gasket shall be set a minimum of 1/8" below exterior glazing stop to create a channel for sealant installation.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.8 FRAMELESS MIRRORS

A. Apply mastic to back of mirror "pats" spaced 4 pats/sq. ft.; adjust mirror so that it is plumb and in place to avoid distortion of reflecting images. Allow 1/8" space between back of mirror and wall surface.

1. Apply "pats" using Palmer Electric Applicator.

B. Apply stainless steel clips at mirror top and bottom; securely clip to substrate using non-corrosive anchors. At drywall back-up anchors must be secured to studs or steel wallplate spanning from stud to stud.

3.9 PROTECTION AND CLEANING

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

E. Cleaning: Clean excess sealant or compound from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.

1. Glass shall be cleaned according to:

a. GANA Glass Information Bulletin GANA 01-0300 – "Proper Procedure for Cleaning Architectural Glass Products."
b. GANA Glass Informational Bulletin GANA TD-02-0402 – Heat Treated Glass Surfaces are Different."

2. Do not use razor blades, scrapers, or metal tools to clean glass.

END OF SECTION

SECTION 088720

ARCHITECTURAL WINDOW FILM

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the architectural window film as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Interior privacy window film.

2. Custom design distraction marking film.

1.3 RELATED SECTIONS

A. Glass and Glazing - Section 088000.

B. Demountable Partitions - Section 102219.

1.4 REFERENCES

A. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.

B. ASTM E 308 - Standard Recommended Practice for Spectophotometry and Description of Color in CIE 1931 System.

1.5 PERFORMANCE REQUIREMENTS

A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E 84:

1. Flame Spread: 25, maximum.

2. Smoke Developed: 450, maximum.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years' experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years' demonstrated experience in installing products of the same type and scope as specified.

1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section. Provide Authorized Dealer # on all documents.

2. Provide a commercial building reference list of 5 properties where the installer has applied specified window film or comparable quality film. This list will include the following information:

    a. Name of building.
    b. The name and telephone number of a management contact.
    c. Type of glass.
    d. Type of film.
    e. Amount of film installed.
    f. Photographs of design work.
    g. Date of completion.

3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques, design draft (for logo and design work) and application workmanship.

1. Finish areas designated by Architect.

2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

3. Refinish mock-up area as required to produce acceptable work.

1.7 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

B. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

C. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

A. At project closeout, provide to Owner or Owner's Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Decorative Film, LLC, or approved equal.

B. Glass film shall be used in custom patterns on interior glazed partitions: Decorative Film, Solyx SXJ-0547 Feather Gradient.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions where architectural window film is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

1. Film shall be installed intact and be removable in the future without damage to the glass.

2. Film shall be installed either in the factory, with protection for it during shipping and installation, or right before erecting window units in the field.

B. Cut film edges neatly and square at a uniform distance of 1/8" to 1/16" of window sealant. Use new blade tips after 3 to 4 cuts.

C. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.

D. Apply film to glass and lightly spray film with slip solution.

E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.

F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.

G. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

SECTION 090160

MAINTENANCE OF TERRAZZO FLOORING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the terrazzo restoration and replacement as shown on the drawings and specified herein, including, but not limited to, the following:

1. Patch and repair existing sand bed cementitious terrazzo floor as required at cracks, adjacent to dismantling and damage caused by construction of adjacent areas.

2. Clean and polish new and existing terrazzo throughout.

3. Custom colors of cementitious terrazzo mixes to match existing terrazzo.

4. All underbeds and fills beneath underbeds required to assure that new terrazzo finish elevations are the correct elevations indicated. Compressive strength (minimum) of underbeds and fills must comply with printed requirements of the manufacturer of the terrazzo materials.

1.3 QUALITY ASSURANCE

A. Overall Standards: Except as otherwise indicated, comply with the standards and recommendations of the "Terrazzo Design/Technical Data Book" issued by the National Terrazzo and Mosaic Association (NTMA).

B. Regulatory Requirements: Contain and collect dust and debris generated by the work in accordance with the requirements of authorities having jurisdiction.

C. Mock-Ups: Execute the following mock-ups under permanent lighting conditions, showing materials, finishes, and methods to be used:

1. Make the following repairs and finish them uniformly with adjacent, existing, cleaned terrazzo:

   a. Install 3 patches where directed, using approved mixes.
   b. Repair crack in terrazzo, at least 3 feet long, using approved mix.
   c. Remove these mock-ups and install additional mock-up repairs until the desired effect is obtained.
   d. Provide mock-up of terrazzo cleaning as directed by the Architect.

D. Tolerance for New Installed Terrazzo: Regardless of the initial condition of substrate, the maximum deviation allowed will be 1/8" in 10 feet measured at any point or direction on the surface.

E. Project Conditions

1. Limits of Work

a. Removal and Dismantling Work: Unless otherwise indicated, extend removal and dismantling terrazzo to the limits of unsound terrazzo and substrate, but not less than to the lines of the next existing joint between area divisions, so that replacement work can be made to existing edges or joints.
b. New Work: Extend installation of new terrazzo areas to the limits of removed and dismantled work (lines of existing joints), (unless otherwise noted) and extend new terrazzo in new areas.

2. Environmental Conditions: Provide not less than 50 foot candles illumination at surfaces where work is in progress.

3. Existing Conditions: Prevent cleaning liquids and other products of the work from running down or over the other materials or areas.

F. Uniformity of Source: Provide materials obtained from only on source for each type of aggregate, cement, joint material, and accessory, to minimize variations in appearance and quality.

1.4 SUBMITTALS

A. Product Data

1. Submit manufacturer's product data with installation instructions for each product to be used in the work, including terrazzo components, admixtures, bonding agents, reinforcement and forming accessories, joint materials, curing materials, finishing materials, and cleaning materials.

2. Submit terrazzo mix designs in written report to the Contractor for each proposed mix at least 15 days prior to placing terrazzo. Do not begin terrazzo installation until mixes have been reviewed and are acceptable to the Architect.

B. Shop Drawings: Submit shop drawings as follows:

1. Show plans of the exact limits of new terrazzo work and limits of each color and finish of terrazzo.

2. Show layout and types of joints, including pour joints, divider strips, control joint strips, and base and border strips.

3. Submit drawings, full size, showing divider-formed inserts of the outlines of the panels as shown on contract drawings, or on supplemental drawings prepared by the Architect.

4. Showing large scale details of joint types, edge conditions, and details of new assembly and repairs, including reinforcing if any.

5. Show areas to be repaired, indicating which approved mix design will be used at the repairs. Include large scale details of repairs.

6. Show spalled cracks and joints proposed for repair.

C. Samples: Submit 2 each of the following samples of new materials:

1. Cured, dry, samples of each color and finish of terrazzo required for new work and for repair work. Make at least 3 trial mixes for each color and finish required, from which the Architect will select the best match or require additional samples if an acceptable match is not obtained. Keep record of exact composition of each mix corresponding to each sample produced.

2. Terrazzo Base: 6" long; full height.

3. Flexible Membrane: 6" x 6", Epoflex with flex grid.

D. Mixing, Placing, Curing Procedures: Submit mixing, placing, and curing procedures to be used that will ensure an exact color and texture match of new terrazzo and terrazzo patches with existing, cleaned terrazzo and with the accepted mock-ups.

E. Survey: Review the existing conditions that required repair and patching of the topping and bed material of the existing terrazzo. Upon completion of survey, submit floor plan marked to the Architect.

F. Closeout Submittals

1. Project Record Documents: Submit documentation and drawings as necessary to explain problems encountered in the work and how they were resolved, together with the acceptance of such resolutions by the Contractor.

2. Maintenance Instructions: Submit written instructions for recommended periodic maintenance.

PART 2 PRODUCTS

2.1 TERRAZZO MATERIALS

A. Terrazzo - Sand Bed Cementitious Type: Match existing field terrazzo in color, texture, matrix, stone aggregate, finish, and all other physical characteristics.

B. Portland Cement: ASTM C 150, Type I, except as modified to comply with NTMA requirements for compressive strength. Obtain cement from a single source for each color.

1. Provide non-staining white cement for terrazzo topping matrix, patches, and grout.

2. Provide standard grey cement for underbed.

C. Sand: ASTM C 33.

D. Aggregate: Natural, sound, crushed marble chips, matching the existing terrazzo aggregate in quantity proportion, size, color, gradation, and shape.

E. Pigments: Pure mineral or synthetic pigments, resistant to alkalies and non-facing. Mix pigments with terrazzo matrix and grout so as to match existing, cleaned terrazzo matrix and when cured.

F. Water: Clean, potable; free of oil, soluble salts, and other deleterious substances.

2.2 TERRAZZO AND GROUT MIXES (CEMENTITIOUS TYPE)

A. General: Determine terrazzo and grout mixes in the field, in conformance with NTMA recommendations. Cured terrazzo and grout is required to match the existing, cleaned terrazzo.

B. Proportions

1. Underbed: As recommended in NTMA guide specifications.

2. Terrazzo Topping: As recommended in NTMA guide specifications, except as needed to match existing, cleaned terrazzo being matched.

3. Grout: Terrazzo topping without large aggregate.

2.3 JOINT MATERIALS

A. Terrazzo to Match Existing - Pour Joints (no actual material used): Cold joints between divisions of the terrazzo, without filler material; formed by casting new terrazzo against cured terrazzo.

B. Divider Strips and Accessory Strips (to match existing): Depth and style required for terrazzo type and thickness. Width, material, and color that matches existing, cleaned divider strips.

C. Divider Strips and Accessory Strips (new): Zinc, 3/16" thick (unless otherwise indicated) of depth required, with an approved method of anchoring, as manufactured by the Manhattan American Terrazzo Strip Co., or approved equal. Buttons shall be of zinc and match strips in color.

D. Control Strips: Double or split units of same material and color as divider strips with 1/8" wide full-depth white neoprene filler, laminated between strip; to movement at indicated control joints.

E. Sealant: Multi-component polyurethane sealants for joint widths as follows:

1. Regular Joint Sealant for Joints Over 1/8": Polyurethane-based, or epoxidized polyurethane based, multi-part elastomeric sealant, complying with ASTM C 920 Type M, Class 25, and colored as required to match adjacent surfaces:

a. Grade P (pourable, self-leveling), Use T, for application in horizontal plane.
b. Sources: Subject to compliance with requirements, provide one of the following, or approved equal:
1). Pourthane by W.R. Meadows, Inc.
2). Urexpan NR-200 by Pecora Corp.
3). Sikaflex 2c-SL by Sika Corp.
4). Sonolastic Paving Joint Sealant by Sonneborn Building Products Div., Rexnord Chemical Products Inc.

2. Thin Joint Sealant for Joints 1/8" or Less: Custom-colored; self-leveling, multi-component polyurethane sealant for "oil-can" application in thin joints as recommended by manufacturer. ASTM C 920 Type M, Class 25, Grade P, Use T, and colored as required to match adjacent surfaces.

3. Primers for Sealant: Use primers recommended by sealant manufacturer for surfaces and conditions indicated.

F. Joint Back-Up Rod: Compressible rod stock of polyethylene foam or polyethylene-jacketed polyurethane foam that will maintain a uniform round or oval cross-sectional shape when compressed into joint and that will not bond to the sealant.

1. Provide size and shape of rod that will control the joint depth for sealant placement, form optimum shape of sealant bead on back side, and provide a highly compressible backup to minimize the possibility of sealant extrusion or puncturing when the joint is compressed or stepped on.

G. Joint Cleaner: Provide the type of joint cleaning compound recommended by the sealant manufacturer for cleaning joint surfaces before priming.

H. Joint Filler: Closed-cell, expanded neoprene complying with ASTM D 1056, Class SC (oil-resistant and medium swell), of 2 to 5 psi compression deflection (Grade SCE 41); except provide 13 to 17 psi compression deflection (Grade SCE 44) wherever filler is applied under sealant exposed to traffic. Use one of the following approved equal:

1. Closed Cell Neoprene by Permaglaze Co.

2. Closed Cell Neoprene by Rubatex Corp.

3. Neoprene NN by Williams Products, Inc.

2.4 ACCESSORIES

A. Substrate Primer: Two-component resin or other compound to penetrate and seal substrate and provide maximum bond of terrazzo to substrate, as recommended by restoration specialist and acceptable to the Architect.

B. Underbed Reinforcement: Galvanized welded wire fabric, 2" by 2", W0.3 x W0.3 (0.06250-inch diameter or 16 ASW gauge); comply with ASTM A 185 and ASTM A 82, except for minimum wire size.

C. Isolation Membrane: Glass-fiber-reinforced polyethylene film not less than 40 mils thick. Flexible Epoxy Membrane: #3552 "Epo-Flex," by General Polymers; provide, prepare and install membrane and epoxy terrazzo over it in strict accordance with manufacturer's printed Technical Data Sheet. Membrane must be compatible with epoxy terrazzo to be installed over it.

D. Curing Compound: Liquid membrane-forming compound, ASTM C 309, Type 1.

E. Floor Sealer: Colorless, slip- and stain-resistant penetrating sealer with pH factor between 7 and 10, that does not affect color or physical properties of terrazzo surface. Slip-resistance 0.60 or greater in accordance with ASTM C 1028.

F. Abrasive Strips

1. Inserts: 16-gauge zinc channel inserts for cast-in-place abrasive filler; by Manhattan American Terrazzo Strip Co., or approved equal.

2. Abrasive Filler: Pre-packaged mortar with zinc oxide particles; Macon Tread Mix by American Mason Safety Tread Co., or Tred-Mix by American Abrasive Metals Co., or approved equal, in selected standard color.

G. Transition Strip: Provide as indicated on Drawings and Finish Schedule.

2.5 CLEANING MATERIALS

A. General Cleaning

1. Cleaner: Chemically neutral liquid cleaner with a pH between 7 and 10, but as near 7 as possible, of formulation recommended by floor sealer manufacturer for type of terrazzo used and complying with NTMA requirements. Do not use soaps nor any scrubbing powders containing water solubles, inorganic salts, or crystallizing salts.

2. Water: Clean, potable; free of oil, soluble salts, and other deleterious substances.

3. Equipment: Electric scrubbing machines.

B. Stain Removers

1. General: Use products as recommended by the restoration specialist and acceptable to the Architect. Comply with the requirements of the Miscellaneous Products and Tools article below.

2. Chemicals: Do not use chemicals unless second application of general cleaning materials prove to be ineffective in removing particular stains and only use chemicals that have been tested and proven effective at an inconspicuous place on the site.

3. Solvents: VOC-compliant solvent solutions to remove grease, chewing gum, and lipstick.

4. Absorbents: Chemically inactive to absorb grease or moist stains.

5. Bleaches: Not acceptable.

2.6 MISCELLANEOUS PRODUCTS AND TOOLS

A. Select materials, tools, and methods of use based upon the following, all as subject to approval by the Architect.

1. Proven effectiveness in cleaning the surfaces involved.

2. Gentleness to original surfaces.

3. Simplicity of use.

4. Uniformity of the resulting overall appearance.

B. Do not use products or tools that could:

1. Remove, alter, or in any way harm the present condition or future preservation of the existing surface, including surrounding surfaces not in contract.

2. Leave a residue on cleaned surfaces.

3. Endanger the health or safety of the public or the personnel performing the work.

PART 3 EXECUTION

3.1 PREPARATION

A. General: Perform preparation for restoration, patching, and cleaning procedures in accordance with the materials and methods demonstrated by the accepted mock-ups. Clean and prepare substrate to comply with NTMA specifications for type of terrazzo application indicated. Clean substrate of loose chips and foreign matter.

B. Inspection: Together with the restoration specialist, examine the substrate and the conditions under which the work is to be performed. If substrate condition would adversely affect achievement of required tolerance, make repairs to substrate before installing terrazzo.

1. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the specialist and the Architect.

2. Remove areas of existing terrazzo as required to accommodate replacement, and prepare substrate as required to install terrazzo.

3. Measure for and order replacement materials as soon as possible to allow adequate lead time and so as not to delay the Construction Schedule.

C. Protection: Provide and maintain effective, non-staining protection for adjacent surfaces and areas below the work during performance of the work.

1. Protect surfaces from damage and from contact with the cleaning compound and mortar droppings.

2. Use proven methods appropriate for the protection of the surface and as approved by the Architect before the materials and methods are initiated.

3. Determine plan for placement of barricades and sequencing of work.

4. Protect the public from dust, spillage, and debris resulting from work of this section.

   a. Proved exhaust ventilation, if necessary, to prevent fumes from reaching the public.
   b. Provide methods and procedures to ensure that nothing can run onto adjacent surfaces or be tracked onto adjacent surfaces by the public.

5. Control and collect waste from restoration operations.

6. Maintain protection in place until completion of work.

3.2 CLEANING

A. General: Perform general cleaning and stain removal operations prior to restoration and patching work.

1. Perform cleaning using materials and methods demonstrated by the approved mock-up.

B. General Cleaning: Unless otherwise instructed by manufacturer of products, clean starting from the higher elevation, continuing across the surface as the work progresses.

1. Use hand and power-driven, stiff, fiber-bristle brushes selected for their cleaning efficiency with the least potential for surface injury.

2. Apply cleaning compounds by hand or power-driven, stiff, fiber-bristle brush.

3. Rinse with clean water, washing away foreign matter. Control the flow of water to prevent damage and hazards. Catch excess water continuously as the work progresses.

4. Grit blasters, sanders, wire brushes, steel wool, or similar abrasives are not acceptable.

C. Stain Removal

1. Before using other materials to remove stains, try to remove stain with a second application of general cleaning materials.

2. Test stain removing-methods at an inconspicuous place on the site.

3. Apply stain removers locally, but over a large enough area to prevent noticeable differentiation in color, rings, or other unsightly differences.

4. Use soft wooden sticks, or similar gentle tools, followed by stiff fiber-bristle brushes to remove stubborn stains, such as chewing gum.

5. Rinse with clean water and clean bristle brushes, washing away foreign matter. Control the flow of water to prevent damage and hazards. Catch excess water continuously as the work progresses.

6. Clean the stain (less than entire surface) so that the cleaned area blends smoothly into the surrounding areas and show no evidence of the stain cleaning upon completion of the work.

3.3 INSTALLATION

A. General: Comply with NTMA recommendations for proportioning mixes, mixing, sequencing division areas for forming pour joints, installing strips, and placing, curing, grinding, grouting, and finishing.

B. Continuity: Provide terrazzo flooring, bases (coves), thresholds, and stair treads and landings without interruptions of seams, except where pour joints, divider strips, and control joints are indicated. Place and finish terrazzo around obstructions to achieve continuous color, pattern, and finish.

C. Pour Joints: Make pour joints to align exactly with existing joints and to be parallel with the joint pattern.

D. Divider and Accessory Strip Joints: Where indicated in new terrazzo and where existing strips are being replaced, install divider and accessory strips in adhesive setting bed in accordance with strip manufacturer's instructions, without voids below strips. Provide mechanical anchorage as required for adequate attachment of strips to substrate. Align new strips exactly with the pattern of existing strips.

E. Control Joints: Provide control joints where indicated by installing control strips with neoprene rubber filler flush with finish floor. Insofar as possible, align control joints exactly with the pattern of existing joints.

F. Surfacing: Grout and grind cured terrazzo topping in accordance with NTMA specifications, except as needed to match existing, cleaned terrazzo being matched.

3.4 PATCHING EXISTING TERRAZZO

A. Patch all holes and patch all other defects in existing terrazzo that is not otherwise indicated to be replaced.

B. Where removal is indicated, existing terrazzo floor finishes are to be removed to the nearest existing divider strip (divider strip to remain).

C. Where holes do not exceed 2" in diameter and occur no closer than 6" apart, the Contractor may, subject to acceptance by the Architect, provide separate patches matching the terrazzo around the hole. For closer spaced holes make a single patch.

D. Either the patching-mix method or plug method as specified below may be used for patches.

E. After installing patch by either method and allowing it to cure hard, abrasively polish surface so that patch is exactly flush with surrounding terrazzo, with zero lipping.

F. Patching-Mix Method

1. After making cured, dry, trial mixes and obtaining the Architect's acceptance of results, prepare a stiff terrazzo topping mixture.

2. Prepare a slurry coat of Portland cement and water, and apply to cleaned substrate. When slurry coat becomes tacky, place terrazzo topping mixture.

3. Tamp and rod terrazzo topping into the hole until it is the same or slightly higher than the adjoining terrazzo; where required, press coarse aggregate into surface of the matrix so as to replicate adjoining surface.

4. When matrix is thumb-print hard, scrape matrix with bristle brushes to get an exact replication of surrounding surface.

5. Surface patch by grinding and burnishing area as required to eliminate evidence of patching.

G. Plug Method

1. Obtain approval from the Architect of an area of existing terrazzo from which matching plugs may be taken. This may only be an area that will be replaced with new poured terrazzo.

2. Core drill plugs so as to retrieve circular pieces at least 3/8-inch thick at any point, with sharp edges.

3. Core drill hole at defect to be patched. Make hole at more than 1/8" in diameter larger than plug and with walls smooth and sharp edged.

   a. Do not bridge terrazzo joints with plugs. Use 2 patching-mix patches instead.
   b. Do not place plugs closer to a joint than 1/2" nor closer than 1/3 in diameter of the plug. Use patching-mix instead.

4. Prepare a slurry coat of Portland cement and water, and apply to cleaned substrate in hole. When slurry coat becomes tacky, place and compact with rod a solid base of underbed mixture, leaving space for plug.

5. Clean out hole, butter underbed with cement slurry plug, and butter plug sides with color-matched grout. Place the plug, and tamp with wood block to align it flush with surrounding terrazzo. Clean off excess grout and ensure that grout joint around plug is full.

3.5 CRACK AND JOINT REPAIR

A. General: Make repairs where cracks and joints have spalled along their edges, thereby becoming wider, collecting dirt, and looking unsightly. The extent of this work will be evaluated and directed on site by the Architect upon review of the shop drawings.

B. Method at Cracks

1. Route out crack with very narrow grinder-tipped drill to remove irregularities for full depth of terrazzo, following path of crack.

2. Clean out debris and dirt from routed crack and moisten with slurry of cement and water.

3. Place color-matched grout into crack and tightly compact, rounding slightly above or exactly flush with surrounding terrazzo.

4. After grout has cured, abrasively polish surface so that repair is exactly flush with surrounding terrazzo, with zero lipping.

C. Method at Joints

1. Route out joint with very narrow grinder-tipped drill to remove irregularities for full depth of terrazzo. Use a guide so that routed groove is absolutely straight and aligned with centerline of joint pattern.

2. Clean out debris and dirt from routed groove and prime for joint sealant.

3. In joints over 1/8", install joint filler, backer rod, and regular joint sealant.

4. In joints over 1/8" or less, install thin joint sealant for full depth of routed groove.

5. Make sealant flush with surrounding terrazzo. Clean off excess in accordance with sealant manufacturer's instructions. Protect until sealant is fully cured.

3.6 FINAL CLEANING, SEALING, AND PROTECTING

A. Clean terrazzo and machine-buff after installing and surfacing operations are completed, complying with sealer manufacturer's instructions.

B. Apply floor sealer to cleaned terrazzo surfaces to comply with sealer manufacturer's instructions.

C. Repair and refinish other surfaces damaged in executing the work. Perform this in accordance with the requirements of other pertinent Specification sections or as directed by the Contractor.

D. Protect terrazzo from damage and wear during remainder of construction operation.

END OF SECTION

SECTION 092900

GYPSUM DRYWALL

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the gypsum drywall as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Gypsum board work for partitions, ceilings, column enclosures, furring, and elsewhere where gypsum drywall work is shown on drawings.

2. Metal supports for gypsum drywall construction.

3. Acoustical insulation for gypsum drywall work.

4. Sealant for gypsum drywall work.

5. Concealed metal reinforcing for attachment of railings, toilet partitions, and other items supported on drywall partitions and walls.

6. Taping and finishing of drywall joints.

7. Installing rings and frames in drywall surfaces for grilles, registers and lighting fixtures.

8. Bracing and connections.

1.3 RELATED SECTIONS

A. Thermal Insulation - Section 072100.

B. Hollow metal door frames - Section 081113.

C. Access Doors - Section 083113.

D. Painting and Finishing - Section 099000.

E. Elevators - Division 14.

F. Rings for grilles, registers and light fixtures - Division 23 and 26.

1.4 QUALITY ASSURANCE

A. The following standards, as well as other standards which may be referred to in this Section, shall apply to the work of this Section:

1. The Gypsum Construction Handbook, latest edition, USG.
2. Construction Guide, latest edition, National Gypsum.
3. ASTM A 568 "Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements For"
4. ASTM C 475 "Standard Specification for Joint Treatment Materials for Gypsum Wallboard Construction"
5. ASTM C 645 "Standard Specification for Non-Structural Steel Framing Members"
6. ASTM C 754 "Standard Specification for Installation of Steel Framing Members to Receive Screw Attached Gypsum Panel Products"
7. ASTM C 840 "Standard Specification for Application and Finishing of Gypsum Board"
8. ASTM C 919 "Standard Specification for Use of Sealants in Acoustical Applications"
9. ASTM C 954 "Standard Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs From 0.033 in. to 0.112 in. in Thickness"
10. ASTM C 1002 "Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Board"
11. ASTM C 1177 "Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing"
12. ASTM C 1178 "Standard Specification for Glass Mat Water Resistant Gypsum Backing Board"
13. ASTM C 1278 "Standard Specification for Fiber-Reinforced Gypsum Panel"
14. ASTM C 1396 "Standard Specification for Gypsum Board"
15. ASTM D 3273 "Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber"

B. Allowable Tolerances: 1/32" offsets between planes of board faces, and 1/16" in 8'-0" for plumb, level, warp and bow.

C. System Design Load

1. Provide standard drywall wall assemblies designed and tested by manufacturer to withstand a lateral load of 5 lbs. per sq. ft. for the maximum wall height required, and with deflection limited to L/240 of partition height.

a. Drywall assemblies with tile finish shall have a deflection limit of L/360.

2. Provide drywall ceiling assemblies designed, fabricated and installed to have a deflection not to exceed L/360.

D. Fire-Resistance Rating: Where gypsum drywall with fire resistance ratings are indicated, provide materials and installations which are identical with those of applicable assemblies tested per ASTM E 119 by fire testing laboratories, or to design designations in UL "Fire Resistance Directory" or in listing of other testing agencies acceptable to authorities having jurisdiction, and compliant with UL Test #2079; criteria for cycle movement for all field height wall sections requiring allowance for vertical deflection within framing details.

E. Installer: Firm with not less than 5 years of successful experience in the installation of specified materials.

F. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance program.

1.5 SUBMITTALS

A. Submit shop drawing for each drywall partition, furring and ceiling system showing size and gauges of framing members, hanger and anchorage devices, wallboard types, insulation, sealant, methods of assembly and fastening, control joints indicating column lines, corner details, joint finishing and relationship of drywall work to adjacent work.

B. Samples: Each material specified herein, 12" x 12", or 12" long, or in manufacturer's container, as applicable for type of material submitted.

C. Manufacturer's Literature: Submit technical and installation instructions for each drywall partition, furring and ceiling system specified herein, and for each fire-rated and sound-rated gypsum board assembly. Submit other data as required to show compliance with these specifications, including data for mold resistant joint compound.

D. Test Reports: This Contractor shall submit test report, obtained by drywall manufacturer, indicating conformance of drywall assemblies to required fire ratings and sound ratings.

E. Evaluation Reports: Submit evaluation reports certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98, IAS Accreditation Criteria for Inspection Agencies.

1.6 DELIVER, STORAGE, AND HANDLING

A. Deliver, store, and handle drywall work materials to prevent damage. Deliver materials in their original, unopened containers or bundles, and store where protected from moisture, damage and from exposure to the elements. Store wallboard in flat stacks.

B. Protect wallboard from becoming wet.

C. Protect metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice."

1.7 ENVIRONMENTAL CONDITIONS

A. Provide and maintain minimum temperature of fifty-five (55) degrees F. and adequate ventilation to eliminate excessive moisture within the building in the area of the drywall work for at least twenty-four (24) hours, prior to, during and after installation of drywall work. Installation shall not start until windows are glazed and doors are installed, unless openings are temporarily closed. Space above suspended ceilings shall be vented sufficiently to prevent temperature and pressure build up.

1.8 JOB MOCK-UP

A. At a suitable location, where directed by the Architect, lay up a portion of a finished wall and ceiling demonstrating the quality of work, including finishing, to be obtained under this Section. Omit drywall boards in locations as directed by the Architect to show stud spacing and attachments; after acceptance, complete assembly.

B. Adjust the finishing techniques as required to achieve the finish required by the Architect as described in this Section of these specifications.

C. Upon approval of the mock-up, the mock-up may be left in place as a portion of the finished work of this Section.

D. All drywall work shall be equal in quality to approved mock-up.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers for Gypsum Drywall Panels and Accessories: U.S. Gypsum Co., Georgia Pacific, CertainTeed Corporation, Continental Building Products, or National Gypsum Co. meeting specification requirements are acceptable.

1. All drywall products must be manufactured in North America.

B. Acceptable Manufacturers for Metal Supports of Drywall Assemblies: Unless otherwise noted, provide products manufactured by ClarkDietrich, Super Stud Building Products, Marino/Ware, or approved equal.

2.2 METAL SUPPORTS

A. Metal Floor and Ceiling Runners

1. Drywall Track: Formed from 0.0312 inch (20 U.S. Std. gauge) (minimum unless otherwise noted or required by performance requirements) cold formed steel, width to suit shaped metal studs. Use 20 ga. top runners with 1-1/4" minimum flanges.

2. Deflection track or head of wall connections at rated partitions shall conform to UL #2079 for cycle movement. Provide positive mechanical connection of framing to structure, allowing for vertical movement within connections. Minimum of 0.0312 (20 ga.) cold formed steel for clips, 25 ga. cold formed steel for deflection track.

a. Product: "BlazeFrame DSL" or "MaxTrak Slotted Deflection Track" as manufactured by ClarkDietrich, "VertiClip" or "VertiTrack" as manufactured by the Steel Network or equal made by Metal-Lite Inc.
b. FireTrak (including stud clips) by FireTrak Corp. or equal made by Metal-Lite Inc.

B. Metal Studs, Framing and Furring

1. C-Shaped Studs: Channel type with holes for passage of conduit formed from minimum 0.0312" (20 U.S. Std. gauge) (unless heavier gauge is required to meet deflection limits) cold formed steel, width as shown on drawings.

2. Furring Channels: Hat shaped, formed from galvanized steel, 25 U.S. Std. gauge.

a. Product: ClarkDietrich; Furring Channel, or a comparable product.

3. Continuous 16 gauge x 8" wide steel wall plate screwed to studs as required for support of railings, toilet partitions and other items supported on drywall partitions and walls.

C. Suspended Ceiling and Fascia Supports

1. Main Runners: 1-1/2" steel channels, cold rolled at 0.475 lbs. per ft., rust-inhibitive paint finish.

2. Furring Members: Screw-type hat-shaped furring channels of 25 ga. zinc-coated steel; comply with ASTM C 645.

3. Hangers: Galvanized, 1" x 3/16" flat steel slats capable of supporting 5x calculated load supported.

4. Hanger Anchorages: Provide inserts, clips, bolts, screws and other devices applicable to the required method of structural anchorage for ceiling hangers. Size devices for 5x calculated load supported.

5. Furring Anchorages: 16 ga. galvanized wire ties, manufacturer's standard clips, bolts or screws as recommended by furring manufacturer.

D. Protective Coating: All cold-formed steel members shall have coating conforming to AISI S220; ASTM A 653, G60 or coating with equivalent corrosion resistance of ASTM A653/A653M, G60. Galvannealed products are not acceptable.

2.3 GYPSUM WALLBOARD TYPES

A. Gypsum Wallboard: 5/8" thick "Sheetrock" by USG, "Gold Bond" by National Gypsum, or "Regular Gypsum" by CertainTeed Corp., 48" wide, in maximum lengths available to minimize end-to-end butt joints.

B. Gypsum Ceiling Board: 5/8" thick, sag-resistant, long edges tapered.

C. Fire-Rated Gypsum Wallboard: 5/8" thick "Sheetrock Firecode C" by USG, "Firecheck Type C" by Lafarge/Continental, "Gold Bond Fireshield" by National Gypsum, or "Type C" and "Type X" by CertainTeed Corp., 48" wide, in maximum lengths available to minimize end-to-end butt joints.

D. Water-Resistant Backing Board for Tile Finish: 1/2" thick, "DUROCK Glass Mat Tile Backerboard" by USG, "Dens-Shield Tile Backer Board" by Georgia Pacific or "DiamondBack Tile Backer" by CertainTeed Corp. Cover joints with a pressure sensitive woven glass fiber tape equal to Imperial Type P Tape.

E. Cement Board Backing for Tile Finish at Showers: 1/2" thick "Durock Tile Backer Board" by USG, "Wonder Board Lite" by Custom Building Products or approved equal.

F. Mold-Resistant Paperless Gypsum Wallboard: 5/8" thick, 48" wide "DensArmour Plus" and "DensArmour Plus Fireguard C" by Georgia Pacific, or equal by National Gypsum, USG or approved equal that has a rating of 10 per ASTM D 3273 with core that meets ASTM C 1396, Section 6 or ASTM C 1658.

G. Moisture/Mold-Resistant Gypsum Wallboard (at all exterior walls and wet areas): 5/8" thick "Mold Tough," "Mold Tough FR," by U.S. Gypsum, "DensArmor Plus" by Georgia Pacific, "Mold Defense" and/or "Mold Defense Type X" by Lafarge/Continental, or "Gold Bond EXP Interior Extreme Gypsum Board" by National Gypsum, 48" wide, in maximum lengths available to minimize end-to-end butt joints.

1. Board must have a rating of 10 per ASTM D 3273 with a core that meets ASTM C 1396, Section 6, or ASTM C 1658.

H. Abuse-Resistant Wallboard: 5/8" thick "Sheetrock Brand Mold Tough AR" by USG, "Dens Armor Plus Abuse Resistant Panels" by Georgia-Pacific, "EXP Interior Extreme AR" or "Gold Bond Brand Hi-Abuse XP" by National Gypsum, "Protecta AR100" or "Protecta HIR 300" by Lafarge/Continental, or "AirRenew Extreme Abuse" by CertainTeed Corp., 48" wide, in maximum lengths available to minimize end-to-end butt joints.

1. Board must achieve a Level 1 rating per ASTM C 1629.

2.4 ACCESSORIES

A. Acoustical Insulation: Paper-less, non-combustible, semi-rigid mineral fiber mat, 2" thick, in walls (unless otherwise indicated), 3 lb./cu. ft. maximum density; Thermafiber "Thermafiber SAFB," Rockwool "Rockwool AFB" or approved equal.

B. Fasteners for Wallboard: USG Brand Screws; Type S Bugle Head for fastening wallboard to lighter gauge interior metal framing (up to 20 ga.). Type S-12 Bugle Head for fastening wallboard to heavier gauge interior metal framing (20 ga. to 12 ga.); Type S and Type S-12 Pan Head for attaching metal studs to door frames and runners; and Type G Bugle Head for fastening wallboard to wallboard. Lengths specified below under "Part 3 - Execution" Articles and as recommended by drywall manufacturer.

1. For Portland cement base boards, fasteners shall be equal to Durock Steel Screws by U.S. Gypsum.

C. Laminating Adhesive: "Sheetrock Brand Joint Compound."

D. Metal Trim - Corner Beads: For 90 degree external corners, provide ClarkDietrich "103 Deluxe Corner Bead (CBU)" or "103 Dur-A-Bead" by USG, 26 U.S. Std. ga. galvanized steel, 1-1/4" x 1-1/4".

E. Metal Trim - Edge Beads: "Sheetrock Brand Paper Faced Metal Bead and Trim."

F. Partition/Concrete Ceiling Trim: Trim-Tex Super Seal Tear Away or approved equal.

G. Metal Trim Treatment Materials and Joint Treatment Materials for Gypsum Drywall Boards: Paper tape for joint reinforcing; Setting Type (Durabond 90) or Lightweight Setting Type Joint Compound for taping and topping; and Ready Mix Compound for finishing.

1. For mold-resistant drywall, water-resistant drywall, and tile backer board, use glass mesh tape with setting joint compound that is rated 10 when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274. Acceptable joint compound is "Rapid Set One Pass" made by CTS Cement Manufacturing Corp. or "Rapid Joint" manufactured by Lafarge North America or approved equal meeting standards noted herein.

H. Control Joints: ClarkDietrich; #093 Control Joint or No. 0.093 by USG.

I. Acoustical Sealant: USG "Acoustical Sealant," Tremco Mfg. Co. "Tremco Acoustical Caulking," BASF "MasterSeal NP520," or approved equal.

J. Neoprene Gaskets: Conform to ASTM D 1056.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where gypsum drywall is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. General

1. Install drywall work in accordance with drywall manufacturer's printed instructions and as indicated on drawings and specified herein.

2. All metal framing for drywall partitions shall extend from floor to underside of structural deck above. Provide for vertical deflection with positive mechanical connections of framing members to structure.

3. Provide concealed reinforcement, 16 ga. thick by eight (8) inches wide or as detailed or as recommended by manufacturer, for attachment of railings, toilet partitions, and other items to be supported on the partitions which cannot be attached to the metal framing members. Concealed reinforcement shall span between metal studs and be attached thereto using two (2) self-tapping pan head screws at each stud.

a. Back of drywall shall be scored or notched to prevent bulging out where reinforcement plate occurs.

B. Fire-Rated Assemblies: Install fire-rated assemblies in accordance with requirements of authorities having jurisdiction, Underwriters' Laboratories and test results obtained and

published by the drywall manufacturer, for the fire-rated drywall assembly types indicated on the drawings.

C. Acoustical Assemblies: Install acoustically-rated assemblies to achieve a minimum STC as noted on drawings, in accordance with test results obtained and published by the drywall manufacturer, for the drywall assembly type indicated on the drawings.

D. Sealant

1. Install continuous acoustical sealant bead at top and bottom edges of wallboard where indicated or required for sound rating as wallboard is installed, and between metal trim edge beads and abutting construction.

2. Install acoustical sealant in 1/8" wide vertical control joints within the length of the wall or partitions, and in all other joints, specified below under "Control Joints." Install bead of acoustical sealant around electric switch and outlet boxes, piping, ducts, and around any other penetration in the wallboard; place sealant bead between penetrations and edge of wallboard.

3. Where sealant is exposed to view, protect adjacent surfaces from damage and from sealant material, and tool sealant flush with and in same plane as wallboard surface. Sealant beads shall be 1/4" to 3/8" diameter.

E. Wallboard Application

1. Do not install wallboard panels until steel door frames are in place; coordinate work with Section 081113, "Steel Doors and Frames."

2. See drawings for all board types. Use fire-rated wallboard for fire-rated assemblies. Use sag-resistant board for ceilings. Use water-resistant wallboard where indicated on drawings and where wallboard would be subject to moisture. Install water-resistant wallboard in full, large sheets (no scraps) to limit number of butt joints.

3. Apply wallboard with long dimension parallel to stud framing members, and with abutting edges occurring over stud flanges.

4. Install wallboard for partitions from floor to underside of structure above and secure rigidly in place by screw attachment, unless otherwise indicated.

5. Provide "Thermafiber" safing insulation meeting standards of Section 078413 at flutes of metal deck where partitions carry up to bottom of metal deck.

6. Neatly cut wallboard to fit around outlets, switch boxes, framed openings, piping, ducts, and other items which penetrate wallboard; fill gaps with acoustic sealant.

7. Where wallboard is to be applied to curved surfaces, dampen wallboard on back side as required to obtain required curve. Finish surface shall present smooth, even curve without fluting or other imperfections.

8. Screw fasten wallboard with power-driven electric screwdriver, screw heads to slightly depress surface of wallboard without cutting paper, screws not closer than 3/8" from ends and edges of wallboard.

9. Where studs are doubled-up, screw fasten wallboard to both studs in a staggered pattern.

F. Cementitious Backer Board

1. General: Furnish cementitious backer board in maximum available lengths. Install horizontally, with end joints over framing members.

2. Fastening: Secure cementitious backer board to each framing member with screws spaced not more than 12 inches on center and not closer than 1/2" from the edge. Install screws with a conventional screw gun so that the screw heads are flush with the surface of the board.

3. Joint Treatment: Fill space between edge of backer and receptor with dry-set Portland cement or latex-Portland cement mortar. Fill all horizontal and vertical joints and corners with dry-set Portland cement or latex-Portland cement mortar. Apply fiberglass tape over joints and corners and embed with same mortar.

G. Metal Trim: Install and mechanically secure in accordance with manufacturer's instructions; and finish with three (3) coats of joint compound, feathered and finish sanded smooth with adjacent wallboard surface, in accordance with manufacturer's instructions.

1. Corner Beads: Install specified corner beads in single lengths at all external corners, unless corner lengths exceed standard stock lengths.

2. Edge Beads: Install specified edge beads in single lengths at all terminating edges of wallboard exposed to view, where edges abut dissimilar materials, where edges would be exposed to view, and elsewhere where shown on drawings. Where indicated on drawings, seal joint between metal edge bead and adjoining surface with specified gasket, 1/8" wide minimum and set back 1/8" from face of wallboard, unless other size and profile indicated on drawings.

3. Casing beads shall be set in long lengths, neatly butted at joints. Provide casing beads at juncture of board and vertical surfaces and at exposed perimeters.

H. Control Joint Locations: Gypsum board surfaces shall be isolated with control joints where:

1. Ceiling abuts a structural element, dissimilar wall or other vertical penetration.

2. Construction changes within the plane of the partition or ceiling.

3. Shown on approved shop drawings.

4. Ceiling dimensions exceed thirty (30) feet in either direction.

5. Wings of "L," "U," and "T" shaped ceiling areas are joined.

6. Expansion or control joints occur in the structural elements of the building.

7. Partition or furring abuts a structural element or dissimilar wall or ceiling.

8. Partition or furring runs exceed 30' without interruption.

9. Where control joints are required, ceiling height door frames may be used as control joints. Less than ceiling height frames shall have control joints extending to the ceiling from both corners.

I. Joint Treatment and Spackling

1. Joints between face wallboards in the same plane, joints at internal corners of intersecting partitions and joints at internal corners of intersections between ceilings and walls or partitions shall be filled with joint compound.

2. Screw heads and other depressions shall be filled with joint compound. Joint compound shall be applied in three (3) coats, feathered and finish surface sanded smooth with adjacent wallboard surface, in accordance with manufacturer's instructions. Treatment of joints and screw heads with joint compound is also required where wallboard will be covered by finish materials which require a smooth surface, such as vinyl wall coverings.

3.3 FURRED WALLS AND PARTITIONS

A. Use specified metal furring channels. Run metal furring channel framing members vertically, space sixteen (16) inches o.c. maximum. Fasten furring channels to concrete or masonry surfaces with power-driven fasteners or concrete stub nails spaced sixteen (16) inches o.c. maximum through alternate wing flanges (staggered) of furring channel. Furring channels shall be shimmed as necessary to provide a plumb and level backing for wallboard. At inside of exterior walls, an asphalt felt protection strip shall be installed between each furring channel and the wall. Furring channel and splices shall be provided by nesting channels at least eight (8) inches and securely anchoring to concrete or masonry with two (2) fasteners in each wing.

B. Wallboard Installation: Same as specified under Article 3.4 - "Metal Stud Partitions."

3.4 METAL STUD PARTITIONS

A. Unless otherwise noted, steel framing members shall be installed in accordance with ASTM C 754.

B. Runner Installation: Use channel type. Align accurately at floor according to partition layout. Anchor runners securely sixteen (16) inches o.c. maximum with power-driven anchors to floor slab, with power-driven anchors to structural slab above. See "Stud Installation" below for runners over heads of metal door frames. Where required, carefully remove sprayed-on fireproofing to allow partition to be properly installed.

C. Stud Installation

1. Use channel type, positioned vertically in runners, spaced as noted on drawings, but not more than sixteen (16) inches o.c.

2. Anchor studs to floor runners with screw fasteners. Provide snap-in or slotted hole slip joint bolt connections of studs to ceiling runners leaving space for movement. Anchor studs at partition intersections, partition corners and where partition abuts other construction to floor and ceiling runners with sheet metal screws through each stud flange and runner flange.

3. Connection at ceiling runner for non-rated partitions shall be snap-in or slotted hole slip joint bolt connection that shall allow for movement. Seal studs abutting other construction with 1/8" thick neoprene gasket continuously between stud and abutting construction.

4. Connections for fire rated partitions at ceiling runners shall conform to UL Design #2079.

5. Install metal stud horizontal bracing wherever vertical studs are cut or wallboard is cut for passage of pipes, ducts or other penetrations, and anchor horizontal bracing to vertical studs with sheet metal screws.

6. At jambs of door frames and borrowed light frames, install doubled-up studs (not back to back) from floor to underside of structural deck, and securely anchor studs to jamb anchors of frames and to runners with screws. Provide cross braces from hollow metal frames to underside of slab.

7. Over heads of door frames, install cut-to-length section of runner with flanges slit and web bent to allow flanges to overlap adjacent vertical studs, and securely anchor runner to adjacent vertical studs with sheet metal screws. Install cut-to-length vertical studs from runner (over heads of door frame) to ceiling runner sixteen (16) inches maximum o.c. and at vertical joints of wallboard, and securely anchor studs to runners with sheet metal screws.

8. At control joints, in field of partition, install double-up studs (back to back) from floor to ceiling runner, with 1/4" thick continuous compressible gasket between studs. When necessary, splice studs with eight (8) inches minimum nested laps and attach flanges together with two (2) sheet metal screws in each flange. All screws shall be self-tapping sheet metal screws.

D. Runners and Studs at Chase Wall: As specified above for "Runners" and "Studs" and as specified herein. Chase walls shall have either a single or double row of floor and ceiling runners with metal studs sixteen (16) inches o.c. maximum and positioned vertically in the runners so that the studs are opposite each other in pairs with the flanges pointing in the same direction. Anchor all studs to runner flanges with sheet metal screws through each stud flange and runner flange following requirements of paragraph 3.4, B. Provide cross bracing between the rows of studs by attaching runner channels or studs set full width of chase attached to vertical studs with one self-tapping screw at each end. Space cross bracing not over thirty-six (36) inches o.c. vertically.

E. Wallboard Installation - Single Layer Application (Screw Attached)

1. Install wallboard with long dimension parallel to framing member and with abutting edge joints over web of framing member. Install wallboard with long dimension perpendicular to framing members above and below openings in drywall extending to second stud at each side of opening. Joints on opposite sides of wall shall be arranged so as to occur on different studs.

2. Boards shall be fastened securely to metal studs with screws as specified. Where a free end occurs between studs, back blocking shall be required. Center abutting ends over studs. Correct work as necessary so that faces of boards are flush, smooth, true.

3. Wallboard screws shall be applied with an electric screw gun. Screws shall be driven not less than 3/8" from ends or edges of board to provide uniform dimple not over 1/32" deep. Screws shall be spaced twelve (12) inches o.c. in the field of the board and 8" o.c. staggered along the abutting edges.

4. All ends and edges of wallboard shall occur over screwing members (studs or furring channels). Boards shall be brought into contact but shall not be forced into place. Where ends or edges abut, they shall be staggered. Joints on opposite sides of a partition shall be so arranged as to occur on different studs.

5. At locations where piping receptacles, conduit, switches, etc., penetrate drywall partitions, provide non-drying sealant and an approved sealant stop at cut board locations inside partition.

F. Wallboard Installation - Double-Layer Application

1. General: See drawings for wallboard partition types required.

2. First Layer (Screw Attached): Install as described above for single layer application.

3. Second Layer (Screw Attached): Screw attach second layer, unless laminating method of attachment indicated on drawings or necessary to obtain required sound rating or fire rating. Install wallboard vertically with vertical joints offset thirty-two (32) inches from first layer joints and staggered on opposite sides of wall. Attach wallboard with 1-5/8" screws sixteen (16) inches o.c. along vertical joints and sixteen (16) inches o.c. in the field of the wallboard. Screw through first layer into metal framing members.

4. Second Layer (Laminated): Install wallboard vertically. Stagger joints of second layer from first layer joints. Laminate second layer with specified laminating adhesive in beads or strips running continuously from floor to ceiling in accordance with manufacturer's instructions. After laminating, screw wallboard to framing members with 1-5/8" screws, spaced twelve (12) inches o.c. around perimeter of wallboard.

G. Wallboard Installation - Laminated Application: Where laminated wallboard is indicated, use specified laminating adhesive, install wallboard vertically and maintain tolerances as specified for screw attached wallboard.

H. Insulation Installation: Install where indicated on drawings. Place blanket tightly between studs.

I. Deflection of Structure Above: To allow for possible deflection of structure above partitions, provide top runners for non-rated partitions with 1-1/4" minimum flanges and do not screw studs or drywall to top runner. Where positive anchorage of studs to top runner is required, anchorage device shall be by means of slotted hole (in clip connection with screw attachment to web of steel through bushings located in slots of clips), or other anchorage device approved by Architect.

J. Control Joints

1. Leave a 1/2" continuous opening between gypsum boards for insertion of surface mounted joint.

2. Back by double framing members.

3. Attach control joint to face layer with 9/16" galvanized staples six (6) inches o.c. at both flanges along entire length of joint.

4. Provide two (2) inch wide gypsum panel strip or other adequate seal behind control joint in fire rated partitions and partitions with safing insulation.

3.5 DRYWALL FASCIAS AND CEILINGS

A. Furnish and install inserts, hanger clips and similar devices in coordination with other work.

B. Secure hangers to inserts and clips. Clamp or bolt hangers to main runners.

C. Space main runners 4'-0" o.c. and space hangers 4'-0" o.c. along runners, except as otherwise shown.

D. Level main runners to a tolerance of 1/4" in 12'-0", measured both lengthwise on each runner and transversely between parallel runners.

E. Metal Furring Channels: Space sixteen (16) inches o.c. maximum. Attach to 1-1/2" main runner channels with furring channel clips (on alternate sides of main runner channels). Furring channels shall not be let into or come in contact with abutting masonry walls. End splices shall be provided by nesting furring channels no less than eight (8) inches and securely wire tying. At any openings that interrupt the furring channels, install additional cross reinforcing to restore lateral stability.

F. Mechanical accessories, hangers, splices, runner channels and other members used in suspension system shall be of metal, zinc coated, or coated with rust inhibitive paint, of suitable design and of adequate strength to support units securely without sagging, and such as to bring unit faces to finished indicated lines and levels.

1. Provide special furring where ducts are over two (2) feet wide.

G. Apply board with its long dimension at right angles to channels. Locate board butt joints over center of furring channels. Attach board with one (1) inch self-drilling drywall screws twelve (12) inches o.c. in field of board at each furring channel; eight (8) inches o.c. at butt joints located not less than 3/8" from edges.

3.6 ERECTION AT COLUMN ENCLOSURES

A. Metal furring supports shall be provided under work of this Section, and shall be cut to lengths as necessary for tight fit such that spacing is not more than sixteen (16) inches o.c.

B. Board shall be fastened securely to supports with screws as specified. Place boards in position with minimum number of joints. Where free ends occur between supports, back-blocking or furring shall be required. Center abutting ends over supports. Correct

work as necessary so that faces of boards are flush, smooth and true. Provide clips or cross furring for attachment as required.

C. All layers shall be screw attached to furring.

D. When column finish called for on drawings to be in the same plane as drywall finish layer, maintain even, level plane.

3.7 FINISHING

A. Taping: A thin, uniform layer of compound shall be applied to all joints and angles to be reinforced. Reinforcing tape shall be applied immediately, centered over the joint, seated into the compound. A skim coat shall follow immediately but shall not function as a fill or second coat. Tape shall be properly folded and embedded in all angles to provide a true angle.

B. Filling: After initial coat of compound has hardened, additional compound shall be applied, filling the board taper flush with the surface. The fill coat shall cover the tape and feather out slightly beyond the tape. On joints with no taper, the fill coat shall cover the tape and feather out at least four (4) inches on either side of the tape. No fill coat is necessary on interior angles.

C. After compound has hardened, a finishing coat of compound shall be spread evenly over and extending slightly beyond the fill coat on all joints and feathered to a smooth, uniform finish. Over tapered edges, the finished joint shall not protrude beyond the plane of the surface. All taped angles shall receive a finish coat to cover the tape and taping compound and provide a true angle. Where necessary, sanding shall be done between coats and following the final application of compound to provide a smooth surface, ready for painting.

D. Fastener Depressions: Compound shall be applied to all fastener depressions followed, when hardened by at least two (2) coats of compound, leaving all depressions level with the plane of the surface.

E. Finishing Beads and Trim: Compound shall be applied to all bead and trim and shall be feathered out from the ground to the plane of the surface. When hardened, this shall be followed by two (2) coats of compound each extending slightly beyond the previous coat. The finish coat shall be feathered from the ground to the plane of the surface and sanded as necessary to provide a flat, smooth surface ready for decoration.

F. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840 and GA-214 of the Gypsum Association.

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 2: Panels that are a substrate for tile, and where indicated.

3. Level 4: Level of finish for surfaces exposed to view shall conform to Level 4.

G. Drywall construction with defects of such character which will mar appearance of finished work, or which is otherwise defective, will be rejected and shall be removed and replaced at no expense to the Owner.

3.8 CLEANING AND ADJUSTMENT

A. At the completion of installation of the work, all rubbish shall be removed from the building leaving floors broom clean. Excess material, scaffolding, tools and other equipment shall be removed from the building.

B. Work shall be left in clean condition ready for painting or wall covering. All work shall be as approved by Architect.

C. Cutting and Repairing: Include all cutting, fitting and repairing of the work included herein in connection with all mechanical trades and all other trades which come in conjunction with any part of the work and leave all work complete and perfect after all trades have completed their work.

3.9 PROTECTION OF WORK

A. Installer shall advise Contractor of required procedures for protecting drywall work from damage and deterioration during remainder of construction period.

END OF SECTION

SECTION 093013

CERAMIC TILING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the ceramic tiling work as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Ceramic and porcelain floor tile, wall tile, and base.
2. Stone saddles.
3. Setting beds, grout and sealant.
4. Waterproofing membrane.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Unit Masonry - Section 042000.

C. Gypsum Drywall - Section 092900.

1.4 REFERENCES

A. ANSI A108 Series/A118 Series - American National Standards for Installation of Ceramic Tile.

B. ANSI A136.1 - American National Standards for Organic Adhesives for Installation of Ceramic Tile.

C. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.

D. ASTM C 150 - Standard Specification for Portland Cement.

E. TCNA - Handbook for Ceramic, Glass and Stone Tile Installation; Tile Council of North America.

F. ISO 13007 - International Standards Organization; Classification for Grout and Adhesives.

G. Large Format Tile (LFT): Tile 15" or larger in any direction and/or 144 sq. in. in size.

1.5 QUALITY ASSURANCE

A. Qualifications of Installers: For cutting, installing and grouting of ceramic tile, use only thoroughly trained and experienced journeyman tile setters who are completely familiar with the requirements of this work, and the recommendations contained in the referenced standards, and the installers are Certified Ceramic Tile Installer (CTI) through the Ceramic Tile Education Foundation (CTEF) or Tile Installer Thin Set Standards (ITS) verification through the University of Ceramic Tile and Stone.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with the following:

1. Manufacture all ceramic tile in accordance with Standard Grade Requirements of ANSI A-137.1.

2. Install all ceramic tile in accordance with the recommendations contained in "Tile Council of North America Handbook for Ceramic, Glass, and Stone Tile Installation (TCNA)," latest edition.

C. Flooring surfaces shall have a minimum wet DCOF AcuTest value of 0.42 and tested per ANSI A326.3 Dynamic Coefficient of Friction of Hard Surface Flooring Materials.

1.6 SUBMITTALS

A. Samples

1. Before any ceramic tile is delivered to the job site, submit to the Architect sample panels, approx. 12" x 12", mounted on hardboard back-up with selected grout color for each color and pattern of ceramic tile and grout specified.

2. Submit 6" length of stone saddles.

3. Submit 12" x 12" samples of waterproofing membrane.

B. Master Grade Certificates: Prior to opening ceramic tile containers, submit to the Architect a Master Grade Certificate, signed by an officer of the firm manufacturing the ceramic tile used, and issued when the shipment is made, stating the grade, kind of tile, identification marks for tile containers, and the name and location of the project.

C. Mock-Ups

1. At an area on the site where approved by the Architect, provide a mock-up ceramic tile installation.

   a. Make the mock-up approximately 36" x 36" in dimension.
   b. Provide one mock-up for each type, class, and color of installation required under this Section.
   c. The mock-ups may be used as part of the Work and may be included in the finished Work when so approved by the Architect.
   d. Revise as necessary to secure the Architect's approval.

2. The mock-ups, when approved by the Architect, will be used as datum for comparison with the remainder of the work of this Section for the purposes of acceptance or rejection.

3. If the mock-up panels are not permitted to be part of the finished Work, completely demolish and remove them from the job site upon completion and acceptance of the work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage

1. Deliver all materials of this Section to the job site in their original unopened containers with all labels intact and legible at time of use.

2. Store all materials under cover in a manner to prevent damage and contamination; store only the specified materials at the job site.

B. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

C. Maintain temperatures at not less than 50 deg. F. in tiled areas during installation and for 7 days after completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

2. Obtain waterproof/crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Waterproof membrane.
3. Metal edge strips.

2.2 MANUFACTURERS OF TILE

A. See Architectural Drawings for exact basis of design specifications.

B. Provide tile as scheduled on the drawings or approved equal meeting these specifications. The Architect reserves the right to pick tile from any price group.

2.3 TRIM AND SPECIAL SHAPES

A. Provide external and internal corners, trim shapes at openings, and all other trim and special shapes to match the tile specified herein, as required by field conditions and drawing details.

B. Aluminum Edge Finishing: Provide anodized aluminum trim at exposed edges of tile, tile corners and transitions, as detailed, to match tile dimensions specified herein and as required by field conditions; as manufactured by Schluter or approved equal.

1. Ceramic Tile Flooring to VCT: Schluter RENO-U.

2.4 STONE SADDLES

A. Provide sound stone of variety selected by the Architect, minimum 3/4" thick, with an abrasive hardness of not less than 10.0, when tested in accordance with ASTM C 241. Cut saddle to fit jamb profile, honed finish.

2.5 SETTING BEDS AND GROUT

A. Portland Cement: ASTM C 150, Type 1.

B. Hydrated Lime: ASTM C 207, Type S.

C. Sand: ASTM C 144, clean and graded natural sand.

D. Reinforcing for Mud Set Systems: 2" x 2" x 16/16 ga. welded wire mesh.

E. Latex Modified Mortar Bed

1. Laticrete 3701 Fortified Mortar Bed.
2. MAPEI, Modified Mortar Bed.
3. Pro Spec, Floor Mud with B-710 SBR Acrylic Additive.

F. Latex-Portland Cement Bond Coat, complying with ANSI A118.4 and ISO 13007, C2ES2P1 with minimum compressive strength of 400 psi.

1. Laticrete, 254 Platinum.
2. MAPEI, Keraflex Super.

3. Pro Spec; Permalastic System consisting of Permalastic Dryset Mortar and Permalastic Admixture.

G. Improved Modified Cement Mortars: For use with large format tile (LFT), complying with ANSI 118.15 and ISO 13007, CSES2PS.

1. Laticrete, MultiMax Lite.

2. Mapei; Keraflex Super.

3. Pro Spec; StayFlex 590.

H. Wall and Base Tile

1. Over masonry and concrete, use a mortar bed leveling coat conforming to ANSI A108.1A followed by a Latex Portland Cement Bond Coat: Laticrete "TriLite," MAPEI "Keraflex Super," or equal by Pro Spec, conforming to ANSI A118.4, ISO 13007-C2ES2P1, and TCA Detail W-211.

2. Over cement board, use a Latex Portland cement mortar bond coat: Laticrete "TriLite," MAPEI, "Keraflex Super," or equal by Pro Spec, conforming to ANSI A118.4, ISO 13007-C2ES2P1, and TCA Detail W-244; coat back of board with waterproof membrane as specified below.

3. Over glass-mat, water-resistant gypsum backer board, use a latex Portland cement mortar bond coat: Laticrete "TriLite," MAPEI "Keraflex Super," or equal by Pro Spec, conforming to ANSI A118.4, ISO 13007- C2ES1P1, and TCA Detail W-245.

I. Floor Tile and Stone Saddle - Mud Set: Set floor tile and stone saddle using Portland Cement mortar setting bed conforming to ANSI A108.1A and latex modified Portland cement bond coat. Basis of Design: Laticrete "254 Platinum" or MAPEI "Keraflex Super," conforming to ANSI A118.4, ISO 13007-C2ES1P1, and TCA Detail F-112.

1. For installation of LFT: Improved Modified Cement Mortars and medium bed; Basis of Design: Laticrete "Multi Max Lite," or MAPEI "Ultraflex LFT," conforming to ANSI 118.15, ISO 13007-C2ES1P1.

J. Floor Tile and Stone Saddle - Thin Set over Waterproof Setting Bed: Set floor tile and stone saddle using thin set latex Portland cement bond coat. Basis of Design: Laticrete "254 Platinum" or MAPEI "Keraflex Super" conforming to ANSI A118.4, ISO 13007-C2ES2P1, and waterproofing membrane conforming to TCA Detail F-122/122A.

1. For installation of LFT: Improved Modified Cement Mortars and medium bed; Basis of Design: Laticrete "Multi Max Lite," or MAPEI "Ultraflex LFT," conforming to ANSI 118.15, ISO 13007-C2ES1P1.

K. Waterproofing Membrane: Complying with ANSI A118.10 and ANSI A118.12; and having IAPMO certification as a shower pan liner; provide "Hydro Ban" made by Laticrete International, "Mapelastic AquaDefense" by MAPEI with factory blended "Bio-Block Antimicrobial," "Redgard" by Custom Building Products, "SikaTile 100 Moisture Guard," ProSpec "B6000," or approved equal.

1. Reinforce membrane with polyester fabric where recommended by manufacturer.

2. Showers: B-415; run waterproofing up full height of walls.

L. Water: Clean, fresh and suitable for drinking.

M. Grout: Complying with A118.7; and ISO 13007, CG2WAF; for grouting ceramic tile, provide a commercial Portland cement grout, Laticrete "PermaColor" or "PermaColor Select," "Ultracolor Plus FA" (additive not required) made by MAPEI, or comparable product by Custom Building Products or approved equal; color as selected by the Architect.

N. Physical Properties: The setting beds and grouts must meet the following physical requirements:

1. Compressive Strength: 3000 psi min.

2. Shear Bond Strength: 500 psi min.

3. Water Absorption: 4.0% max.

4. Service Rating (ASTM C 627): Extra Heavy Duty.

O. Sealer: Seal all grout joints and all unglazed tile using "StoneTech Heavy Duty Sealer" by Laticrete, "Sealer's Choice 15 Gold" by Aqua Mix Inc. or "Ultracare Penetrating Plus Stone, Tile, and Grout Sealer" by MAPEI.

P. Temporary Protective Coating: Either product indicated below that is applied in the tile manufacturer's factory and formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, applied hot, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg. F. per ASTM D 87.

2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

Q. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, equal to "StoneTech Stone & Tile Cleaner" by Laticrete, "Concentrated Stone & Tile Cleaner" Aqua-Mix, "Ultracare Concentrated Tile & Grout Cleaner" by MAPEI, or approved equal, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.6 SEALANT

A. Joint Backing: Preformed, compressible, resilient, non-extruding, non-staining strips of foam neoprene, foam polyethylene, or other material recommended by sealant manufacturer.

B. Bond Breaker: Polyethylene tape, 3 mils thick, or other material recommended by sealant manufacturer.

C. Sealant Primer: Colorless, non-staining, or type to suit substrate surface, as recommended by sealant manufacturer.

D. Sealant: One-part silicone based sanitary sealant, conforming to ASTM C 920, Type S, Grade NS, Class 25. Sealant hardness upon full cure shall be between 20-30 Shore "A" Durometer. Color of sealant to blend with or match adjacent materials, and as selected by the Architect. Sealant shall be equivalent to 1700 Sanitary Sealant made by General Electric or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where ceramic tile is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels in Floors: + 1/8" in 10'-0" distance and 1/4" total max. variation from levels shown.

B. Grind or fill concrete and masonry substrates as required to comply with allowable variations.

C. Concrete substrates must meet ANSI A108.01 tolerances and surface textures in preparation for tile work. Coordinate with concrete trades.

3.3 PREPARATION

A. Coordinate the following with Section 033000:

1. Steel trowel and fine broom finish concrete slabs that are to receive ceramic tile. Cure concrete slabs that are to receive tile before tile application. Do not use liquid curing compounds or other coatings that may prevent bonding of tile setting materials to slabs. Slab shall be dry at time of tile installation.

2. Tile floors with floor drains must have a slope to direction of 1/4" per foot; coordinate this with concrete trades.

B. Etch concrete substrate as may be required to remove curing compounds or other substances that would interfere with proper bond of setting bed. Rinse with water to remove all traces of treatment.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at project site before installing.

D. Field Applied Temporary Protective Coating: Pre-coat tile with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.4 JOINTS IN TILE WORK

A. Joint Widths: 1/16" wide in ceramic tile.

B. Alignment: Wall, base and floor joints shall align through the field and trim. Direction and location of all joints as directed by Architect.

C. Movement Joints: Conform to TCA Detail EJ171. Locate where movement joints are in back-up material. Provide movement joint at joints between mop receptors and ceramic tile. Provide movement joint at all vertical internal joints of wall tile. Movement joints 1/8" wide in ceramic tile. Fill all movement joints with specified backing and sealant. Use bond breaker where sufficient space for joint backing does not exist.

1. Provide sealant between ceramic tile and plumbing fixtures, mirrors, pipes, countertops and other dissimilar materials penetrating or adjacent to ceramic tile.

3.5 INSTALLATION

A. Comply with the following installation standards:

1. Wall tile over cement board or glass mat backer board using dry set mortar with latex additive - ANSI A118.4 and ISO 13007, C2ES1P1.

2. Wall tile over masonry or concrete using dry set mortar with latex additive - ANSI A118.4 and ISO 13007, C2ES1P1.

3. Floor tile using full mud set mortar - ANSI A118.4, A228.15, and ISO 13007, C2ES1P1.

4. Floor tile using dry set mortar with latex additive - ANSI A118.4, A118.15, and ISO 13007, C2ES1P1.

5. Floor tile over waterproofing membrane - A118.15, and ISO 13007, C2ES1P1.

B. Backs of tile must be cleaned before installation.

C. All setting beds and/or adhesives shall provide for an average contact area of not less than 95% coverage.

D. Allowable Variations in Finished Work: Do not exceed the following deviations from level and plumb, and from elevations, locations, slopes and alignment shown.

1. Floors: 1/8" in 10'-0" run, any direction; +/- 1/8" at any location; 1/32" offset at any location.

2. Walls: 1/8" in 8'-0" run, any direction; 1/8" at any location; offset at any location, 1/32".

3. Joints: +/- 1/32" joint width variation of any location; 1/16" in 3'-0" run deviation from plumb and true.

E. Waterproofing Membrane

1. Install the membrane in strict accordance with manufacturer's written recommendations.

2. Upon completion of work, test horizontal membrane for leaks by flood testing per ASTM D 5957. Inspect for leakage. Make necessary adjustments to stop all leakage and retest until watertight. If membrane is not immediately covered by another surface, provide protection until membrane is covered.

F. Handle, store, mix and apply setting and grouting materials in compliance with the manufacturer's instructions.

G. Extend tile work into recesses and under equipment and fixtures, to form a complete covering without interruptions. Terminate work neatly at obstructions, edges and corners without disruption of pattern or joint alignment.

H. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight, aligned joints. Fit tile closely to electrical outlets, piping and fixtures so that plates, collars, or covers overlap tile.

I. Lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are the same size. Lay out tile work and center tile fields both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths.

3.6 INSTALLATION OF STONE SADDLES

A. Install stone saddles cut to profiles and sizes shown, accurately fitted to jambs, coped at stops, set in full bed of mortar herein specified, and with grouted edge joints as specified for floor tile.

3.7 CLEANING AND PROTECTION OF CERAMIC TILE

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.

2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use cleaners only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning to insure removal of all cleaning material.

3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with Kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. Apply coat of sealer to all grout joints and all unglazed tile.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings from tile surfaces.

E. Leave finished installation clean and free of cracked, chipped, broken, unbonded or otherwise defective tile work.

END OF SECTION

SECTION 095113

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the acoustical panel ceilings as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Acoustical panel units.
2. Exposed "T" suspension system, including hangers and inserts.
3. Provisions for the installation of lighting fixtures, diffusers, grilles and similar items provided under other Sections.
4. Cutting, drilling, scribing and fitting as required for electro-mechanical penetrations.
5. Perimeter and column moldings, trim and accessories for acoustical ceilings.

1.3 RELATED SECTIONS

A. Steel Deck - Section 053100.

B. Gypsum Drywall - Section 092900, for drywall ceilings.

C. HVAC - Division 23, for diffusers, grilles, and related frames.

D. Electrical - Division 26, for lighting fixtures.

1.4 QUALITY ASSURANCE

A. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations published by the Ceilings and Interior Systems Contractor’s Association.

B. Qualifications of Installers

1. The suspended ceiling subcontractor shall have a record of successful installation of similar ceilings acceptable to Architect and shall be currently approved by the manufacturer of the ceiling suspension system.

2. For the actual fabrication and installation of all components of the system, use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

C. The work is subject to the following standards:

1. ASTM C 635 "Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings," American Society for Testing and Materials.

2. ASTM C 636 "Standard Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels," American Society for Testing and Materials.

D. In addition to suspension system specified, provide seismic struts and seismic clips to meet seismic standards as required by prevailing Codes and Ordinances.

1.5 SUBMITTALS

A. Shop Drawings: Submit completely dimensioned ceiling layouts for all areas where acoustical ceilings are required, showing:

1. Any deviations from Architect's reflected ceiling plan layouts, especially lighting fixture and dimensions. Also indicate if any light fixtures will not fit into Architect's ceiling layout due to dimensional restrictions or field conditions.

2. Direction and spacing of suspension members and location of hangers for carrying suspension members.

3. Direction, sizes and types of acoustical units, showing suspension grid members, and starting point for each individual ceiling area.

4. Moldings at perimeter of ceiling, at columns and elsewhere as required due to penetrations or exposure at edge of ceiling tiles.

5. Location and direction of lights, air diffusers, air slots, and similar items in the ceiling plane.

6. Details of construction and installation at all conditions.

7. Materials, gauges, thickness and finishes.

B. Samples and Product Literature: Submit the following samples and related manufacturer's descriptive literature.

1. Twelve (12) inch long components of suspension systems, including moldings.

2. Acoustical units — full size.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Do not install acoustical ceilings until wet-work in space is completed and nominally dry, work above ceilings has been completed, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, fire suppression system components, and partition system.

1.9 EXTRA STOCK

A. Extra Stock: Deliver stock of maintenance material to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2.0% of amount installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

A. See Architectural Drawings for exact basis of design specifications.

2.2 SUSPENSION SYSTEM

A. Provide exposed "T" steel suspension system with low sheen white baked enamel finish as manufactured by Armstrong World Industries, or comparable product made by USG Interiors, Inc., Chicago Metallic Corp., or approved equal.

B. The suspension system shall support the ceiling assembly shown on the drawings and specified herein, with a maximum deflection of 1/360 of the span, in accordance with ASTM C 635.

C. Provide min. 12 ga. galvanized wire hangers, soft annealed steel conforming to ASTM A 641, prestretched, Class 1 zinc coating, soft temper, size so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire.

D. Provide ceiling clips and inserts to receive hangers, type as recommended by suspension system manufacturer, sizes for pull-out resistance of not less than five (5) times the hanger design load, as indicated in ASTM C 635.

E. Suspension systems shall conform to ASTM C 635, intermediate duty.

F. Provide manufacturer's standard wall moldings with off-white baked enamel finish to match suspension systems. For circular penetrations of ceilings, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas where acoustical panel ceilings are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected to permit proper installation of the layout.

3.2 PREPARATION

A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.

B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

A. Codes and Standards: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations and industry standards.

B. Install suspension systems to comply with ASTM C 636, with wire hangers supported only from building structural members. Locate hangers not more than 6" from each end and spaced 4'-0" along direct-hung runner, leveling to tolerance of 1/8" in 12'-0".

C. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.

D. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, reinforcing, countersplaying or other equally effective means.

E. Install edge moldings at edges of each acoustical ceiling area, and at locations where edge of acoustical units would otherwise be exposed after completion of the work.

1. Secure moldings to building construction by fastening through vertical leg. Space holes not more than 3" from each end and not more than sixteen (16) inches o.c. between end holes. Fasten tight against vertical surfaces.

2. Level moldings with ceiling suspension system, to a level tolerance of 1/8" in 12'-0".

F. Install acoustical units in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

G. Install hold-down clips in toilet areas, and in areas where required by governing regulations; space 2'-0" o.c. on all cross tees.

H. Light fixtures or other ceiling apparatus shall not be supported from main beams or cross tees if their weight causes the total load to exceed the deflection capability of the ceiling suspension system. In such cases the load shall be supported by supplemental hangers furnished and installed by this Section of work.

I. Where fixture or ceiling apparatus installation causes eccentric loading on runners, provide stabilizer bars to prevent rotation.

3.4 ADJUST AND CLEAN

A. Clean exposed surfaces of acoustical ceilings, including trim, edge molding, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096466

WOOD ATHLETIC FLOORING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the wood athletic flooring, as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. System construction shall include manufactured method of stop blocking throughout entire floor for protective resilient pad housing and full subfloor support under significant non-athletic loads.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Carpentry - Section 062000.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Specialized wood flooring firm with not less than three (3) years successful experience in installation of types specified, and acceptable to manufacturer of wood flooring.

B. Source Quality Control: Obtain flooring of each type from single manufacturer or source, to ensure match of quality, color, pattern and texture.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's detailed technical product data and installation instructions for each type of wood flooring. Include instructions for handling, storage, installation, finishing, protection, and maintenance.

B. Samples: Submit sets of range samples for wood flooring; include finish.

1.6 DELIVERY, STORAGE AND HANDLING

A. Moisture Content: At time of delivery, limit average moisture content of wood flooring to 12%, with 14% maximum for any piece.

B. Protect wood flooring from excessive moisture in shipment, storage, and handling. Deliver in unopened cartons or bundles and store in a dry place, with adequate air circulation. Do not deliver material to building until "wet work" such as concrete and plaster have been completed and cured to a condition of equilibrium.

1.7 PROJECT CONDITIONS

A. Conditioning: Do not proceed with installation of wood flooring until spaces have been enclosed and are at approximate humidity condition planned for occupancy. Condition wood for five (5) days prior to start of installation by placing in spaces to receive flooring and maintaining ambient temperature between 65 degrees F. and 70 degrees F. before, during and after installation. Open packages of wood flooring which are sealed to permit natural adjustment of moisture content.

1.8 SPECIAL PROJECT WARRANTY

A. Submit three (3) year warranty signed by Manufacturer and Contractor agreeing to repair or replace wood flooring which shrinks, warps, cracks, or otherwise deteriorates excessively, or which breaks its anchorage or bond with substrate or otherwise fails to perform as required, due to failures of materials and/or workmanship and not due to unusual exposure to moisture or other abusive forces or elements not anticipated for application.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Provide gymnasium wood flooring "Focus" manufactured by Connor Sports Flooring Corp., or approved equal.

2.2 SYSTEM

A. System construction shall include Athletic Response Ridge design providing for (1st) light and (2nd) aggressive athletic load response.

B. System construction shall include manufactured method of stop blocking throughout entire floor for protective resilient pad housing and full subfloor support under significant non-athletic loads.

C. Resilient pads shall be linear, aligned continuously perpendicular to flooring direction, average spacing of 8” (203mm) on center.

D. Closed cell polyethylene foam shall not be included as a resilient component.

E. Subfloor shall provide full surface plate throughout, manufactured of minimum 3/4" (19mm) 7-ply plywood.

F. Subfloor panels shall be integrated with attachment of extending edges on all sides.

G. Installation method of subfloor system shall include special anchorage tool to prevent excessive compression of resilient components.

H. Vent base.

2.3 MATERIALS FOR FLOOR SYSTEM

A. Vapor Barrier - 6-mil (0.2mm) polyethylene.

B. Resilient Pads

1. Connor 9/16” (14mm) X 1” (25mm) X 48” (1219mm) Focus FR 825 resilient pads.

C. Subfloor

1. Connor pre-manufactured 3/4” (19mm) subfloor panels providing machined Focus pad slots, anchor pockets, and attached Focus pads.

D. Flooring (Connor Laytite Maple)

1. 25/32” (20mm) X 2-1/4” (57mm), First & Better Grade, Northern Hard Maple Flooring, TGEM, MFMA Grade marked and stamped as manufactured by Connor Sports, Amasa, MI.

E. Fasteners

1. Flooring Fasteners -1-1/2” (38mm) barbed cleats or coated staples.

2. Subfloor Fasteners - 3/4” (19mm) staples or equivalent.

3. Subfloor Adhesive - PL400 adhesive or equal.

F. **Finish Materials** - Connor oil modified polyurethane seal and finish or equal.

G. **Game Lines** - Game line paint shall be compatible with finish.

H. **Wall Base** - 3” (76mm) X 4” (102mm), heavy duty, molded, vented cove base with pre-molded outside corners.

I. **Protective Floor** Cover – (specify or delete) Provide court tiles selected from manufacturer’s standard dimensions and colors.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where wood athletic flooring is to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 SUBFLOOR

A. Cover concrete with poly, lapping joints a minimum of 6” (152mm).

B. Arrange subfloor panels in a staggered brick pattern perpendicular to finished flooring direction with panel ends offset 48” (1219mm) in alternating rows. Attach overlapping side and end joints of adjacent panels by applying ribbon of subfloor adhesive, and 3/4” (19mm) staples 12” (305mm) on center. Provide nominal 1/4” (6mm) spacing between panel edges and provide 1-1/2” (38mm) expansion voids at perimeter and at all vertical obstructions. Install sold blocking at doorways, under bleachers in the stacked position and below portable goals.

C. Secure panels to concrete with steel anchors inserted into anchor pockets provided. Maintain proper anchor penetration with Connor installation tools and procedures.

3.3 MAPLE FLOORING

A. Install maple flooring by power nailing or stapling approximately 10” (254mm) on center with end joints properly driven up.

B. If required, size joints between flooring strips to allow for intermediate expansion in accordance with local humidity conditions.

C. Provided 1-1/2” (38mm) expansion voids at perimeter and at all vertical obstructions.

3.4 FINISHING

A. Maple Flooring

1. Machine sand with coarse, medium, and fine paper to a smooth, even and uniform surface.

2. Remove sanding dust from entire surface by tack or vacuum.

3. Inspect entire area of floor to insure surface is acceptable for finishing, clean and completely free from sanding dust.

4. Apply two (2) coats of approved seal and two (2) coats of approved finish per manufacturer’s instructions.

5. Buff and clean floor between coats.

6. Games Lines: Apply game lines as indicated on drawings, between seal and first coat of finish.

3.5 BASE INSTALLATION

A. Install vent cove base to walls with base cement or screws. Use pre-molded outside corners and mitered inside corners.

3.6 PROTECTION

A. Prohibit traffic on finished floor for a minimum of 10 days. Protect completed wood flooring during remainder of construction period so that finish is allowed to properly cure, and flooring and finish will be without damage or deterioration at time of acceptance.

END OF SECTION

SECTION 096513

RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient base and accessories as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Vinyl base.

2. Rubber stair treads, risers, and landings.

3. Accessories.

1.3 RELATED SECTIONS

A. Steel Pan Stairs - Section 055113.

B. Gypsum Drywall - Section 092900.

C. Resilient Tile Flooring - Section 096519.

D. Carpet Tile - Section 096813.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

B. Provide Class II materials for interior floor finishes in enclosures for stairways, ramps, exit passageways, corridors, and rooms or spaces not separated from corridors by full-height partitions.

1.5 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's technical information and installation instructions for type of resilient base.

B. Samples

1. Submit full-size sample tiles for each type and color required, representative of the expected range of color and pattern variation. Sample submittals will be reviewed

for color, texture and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

2. Submit six (6) inch long samples of base and transitions.

3. Submit full-size sample of stair tread.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gauge, lot number and sequence of materials.

B. Carefully handle all materials and store in original containers at not less than seventy (70) degrees F. for at least forty-eight (48) hours before start of installation.

1.7 JOB CONDITIONS

A. Continuously heat spaces to receive base to a temperature of seventy (70) degrees F. for at least forty-eight (48) hours prior to installation, whenever project conditions are such that heating is required. Maintain seventy (70) degrees F. temperature continuously during and after installation as recommended by the manufacturer, but for not less than forty-eight (48) hours. Maintain a temperature of not less than fifty-five (55) degrees F. in areas where work is completed.

PART 2 PRODUCTS

2.1 VINYL BASE

A. See Architectural Drawings for exact basis of design specifications.

B. Provide 4" high by 1/8" thick continuous vinyl top set cove base with pre-formed internal and external corner pieces, color as selected by the Architect. For areas to receive carpet, provide flat base, no cove. Base shall conform to ASTM F 1861, Type TV, Group 1 (solid) as manufactured by Johnsonite/Tarkett, Nora Systems, Inc., Roppe, or approved equal.

C. Vinyl base shall meet requirements of ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials, Class A, Smoke Developed <450.

D. Burning Characteristics of Building Materials, Class A, Smoke Developed <450.

2.2 STAIR TREADS, RISERS, AND LANDINGS

A. Provide integral rubber stair tread and riser as manufactured by Johnsonite/Tarkett, Nora Systems, Inc., Roppe, or approved equal, homogenous rubber compound with raised design, conforming to ASTM F 2169, Type TS. Provide in lengths and depth to fit tread of stair. Nosings shall be square, adjustable to fit angle of stair nosing, 1-1/2" height. Treads shall include a 2-inch-wide grit tape strip of contrasting color to comply with ADA requirements. Color(s) shall be as scheduled on the drawings. Treads shall conform to ASTM E 648 Class 1 flammability requirements.

B. Landing Tile: Rubber tile matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

2.3 ACCESSORIES

A. Adhesives: Waterproof, stabilized type, as recommended by the manufacturer for the type of service indicated.

B. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

C. Concrete Slab Primer: Non-staining type recommended by the tile manufacturer.

D. Leveling Compound: Refer to Section 035416.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient base and accessories are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Bases: In all spaces where base is indicated, install bases tight to walls, partitions, columns, built-in cabinets, etc., without gaps at top or bulges at bottom, with tight joints and flush edges, with molded corner pieces at internal and external corners. Provide end stops adjacent to flush type door frames and where base does not terminate against an adjacent surface. Keep base in full contact with walls until adhesive sets.

B. Stair Treads

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.

2. Tightly adhere to substrates throughout length of each piece.

3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

3.3 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from base using neutral type cleaners as recommended by the manufacturer.

END OF SECTION

SECTION 096516

RESILIENT SHEET FLOORING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient sheet flooring as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Resilient sheet flooring and cove base.

2. Adhesive.

3. Accessories.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Gypsum Drywall - Section 092900.

C. Resilient Base and Accessories - Section 096513.

D. Resilient Tile Flooring - Section 096519.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

1.5 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's technical information and installation instructions for type of resilient sheet flooring required.

B. Samples: Submit samples of each color of resilient sheet flooring required. Provide twelve (12) inch square samples to illustrate the range of color and pattern variation. Sample submittals will be reviewed for color, texture and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

1. Submit 12 long sample of heat welded seam.

C. Maintenance Instructions: Submit two (2) copies of manufacturer's written instructions for recommended maintenance practices for each type of resilient sheet flooring.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F. or more than 85 deg F., in spaces to receive resilient sheet flooring during the following time periods:

1. 48 hours before installation.

2. During installation.

3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F. or more than 95 deg F.

C. Close spaces to traffic during resilient sheet flooring installation.

D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.

E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

PART 2 PRODUCTS

2.1 SHEET VINYL FLOORING

A. See Architectural Drawings for exact basis of design specifications.

B. Provide 0.080" thick sheet vinyl flooring conforming to ASTM F 1303, Type II. Grade 1, Class A backing, in seventy-two (72) inch wide rolls. Flame spread seventy-five (75) or less. Colors and patterns as selected by the Architect.

2.2 ACCESSORIES

A. Adhesives: Waterproof, stabilized type, as recommended by the manufacturer for the type of service indicated.

B. Leveling Compound: Refer to Section 035416.

C. Edging Strips: 1/8" thick, homogeneous vinyl composition, tapered or bullnose edge, color as selected by the Architect.

D. Concrete Slab Primer: Non-staining type as recommended by the sheet flooring manufacturer.

E. Finish

1. Cleaner shall be equal to "Super Shine All" made by Hillyard Chemical Co., or approved equal.

2. Wax shall be equal to "Super Hil-Brite" made by Hillyard Chemical Co., or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient sheet flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:

   a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft in 24 hours.
   b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum **75** percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient sheet flooring until it is the same temperature as the space where it is to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 INSTALLATION

A. Install sheet flooring only after all finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by sheet flooring manufacturer.

B. Flooring shall be installed to a tolerance of 1/8" in 10'-0" run; 1/32" offset at any location.

C. Place sheet flooring with adhesive cement in strict compliance with the manufacturer's recommendations. Butt tightly to vertical surfaces, thresholds, nosings and edgings. Scribe around obstructions and to produce neat joints, laid tight, even and in straight, parallel lines. Extend sheet flooring into toe spaces, door reveals, and into closet and similar openings.

D. Provide integral cove base where scheduled, including cove support strip and aluminum top edge strip. Construct coved base in accordance the manufacturer's instructions.

E. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on the finish flooring as marked in the subfloor. Use chalk or other non-permanent marking devices.

F. Lay sheet flooring to substrate without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections.

G. Lay sheet flooring to provide as few seams as possible. Match edges for color shading and pattern at seams in compliance with the manufacturer's recommendations, such as reversing adjoining sheets of the same roll, so that abutting edges are from the same edge of the roll.

H. Weld seams in vinyl sheet flooring in compliance with the manufacturer's instructions to provide a "seamless" installation.

I. Place resilient edge strips tightly butted to sheet flooring and secure with adhesive. Provide edging strips at all unprotected edges of sheet flooring, unless otherwise shown.

3.4 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from sheet flooring, using neutral type cleaners as recommended by the sheet flooring manufacturer. Protect installed flooring from damage by use of heavy Kraft paper or other covering.

B. Finishing: After completion of the project and just prior to the final inspection of the work, thoroughly clean resilient sheet floors and accessories. Apply two (2) coats of wax and buff using materials as specified herein.

END OF SECTION

SECTION 096519

RESILIENT TILE FLOORING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient tile flooring, as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Luxury vinyl tile.

2. Transition strips.

3. Accessories.

1.3 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

B. All adhesives must contain low or no VOCs. VOC levels in grams per liter must be less than or equal to thresholds established by the latest version of South Coast Air Quality Management District (SCAQMD) Rule 1168.

C. Resilient Tile Flooring must comply with the requirements of Scientific Certification Systems FloorScore Standard.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of resilient tile flooring. Include sheet flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts. Show details of special patterns.

C. Samples: For each type of resilient tile flooring, in manufacturer's standard size, but not less than 6-by-9-inch sections of each color, texture, and pattern required.

D. Submit manufacturer’s warranty as noted herein.

E. Certificates: Submit Scientific Certification Systems FloorScore Standard Certificates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gauge, lot number and sequence of materials.

B. Carefully handle all materials and store in original containers at not less than seventy (70) degrees F. for at least forty-eight (48) hours before start of installation.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F. or more than 95 deg F., in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.

2. During installation.

3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F. or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 WARRANTY

A. Provide manufacturers 5-year limited warranty.

1.8 ATTIC STOCK

A. Extra Stock: Deliver stock of maintenance material to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.

1. Furnish quantity of full-size units equal to one box for every fifty boxes of installed amount of each resilient flooring type and size.

PART 2 PRODUCTS

2.1 LUXURY VINYL TILE (LVT)

A. See Architectural Drawings for exact basis of design specifications.

B. Provide 0.080" solid vinyl tile conforming to ASTM F 1700, Class III, Type B, as manufactured by Armstrong, Interface, Mannington Commercial, or approved equal; color as scheduled on the drawings. Refer to Finish Schedule on the drawings for selections. Provide tile units with uniformly distributed color and pattern throughout

the thickness of tile. Variations in shades and off-pattern matches between containers are not acceptable.

1. LVT Flooring: Vinyl flooring 2.5 mm thick and 5 mm thick, with 22 mil wear layer; Floorscore certified.

2.2 ACCESSORIES

A. Adhesives: Waterproof, stabilized type, as recommended by the tile manufacturer for the type of service indicated.

B. Concrete Slab Primer: Non-staining type recommended by the tile manufacturer.

C. Leveling Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

D. Edging Strips: 1/8" thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color as selected by the Architect from manufacturer's standards.

E. Rubber Transition Strips: "Slim Line Transitions" as manufactured by Johnsonite, or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient tile flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels (Floors): ± 1/8" in 10'-0" distance and 1/4" total maximum variation from levels shown.

B. Grind or fill concrete substrates as required to comply with allowable variation.

3.3 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within

range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

   a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.
   b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum **75** percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.4 INSTALLATION

A. Install tile only after all finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by tile manufacturer.

B. Place tile units with adhesive cement in strict compliance with the manufacturer's recommendations. Butt tile units tightly to vertical surfaces, thresholds, nosings and edgings. Scribe around obstructions and to produce neat joints, laid tight, even and in straight, parallel lines. Extend tile units into toe spaces, door reveals, and into closet and similar openings.

C. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on the finish tile as marked in the subfloor. Use chalk or other non-permanent marking devices.

D. Lay tile from center marks established with principal walls, discounting minor off-sets, so that tile at opposite edges of the room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown.

E. Match tiles for color and pattern by using tile from cartons in the same sequence as manufactured and packaged. Cut tile neatly to and around all fixtures. Broken, cracked, chipped or deformed tile is not acceptable.

F. Tightly cement tile to sub-base without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks through tile, or other surface imperfections.

G. Lay tile with grain in all tile running in the same direction.

H. Place resilient edge strips tightly butted to tile and secure with adhesive. Provide edging strips at all unprotected edges of tile, unless otherwise shown.

3.5 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from tile, using neutral type cleaners as recommended by the tile manufacturer. Protect installed flooring from damage by use of heavy Kraft paper or other covering.

B. Finishing: After completion of the project and just prior to the final inspection of the work, thoroughly clean tile floors and accessories. Apply finishing materials as recommended by flooring manufacturer.

END OF SECTION

SECTION 096536

STATIC-CONTROL RESILIENT FLOORING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the static-control resilient flooring, as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Static-dissipative vinyl composition tile (VCT).

2. Adhesive.

3. Accessories.

1.3 RELATED SECTIONS

A. Resilient Base and Accessories - Section 096513.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

1.5 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's technical information and installation instructions for type of resilient tile.

B. Samples: Submit full-size sample tiles for each type and color required, representative of the expected range of color and pattern variation. Sample submittals will be reviewed for color, texture, and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

C. Maintenance Instructions: Submit two (2) copies of manufacturer's written instructions for recommended maintenance practices for each type of resilient flooring.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gauge, lot number and sequence of materials.

B. Carefully handle all materials and store in original containers at not less than seventy (70) degrees F. for at least forty-eight (48) hours before start of installation.

PART 2 - PRODUCTS

2.1 STATIC-DISSIPATIVE RESILIENT FLOORING

A. See Architectural Drawings for exact basis of design specifications.

B. Static-Dissipative Tile: Provide 12" x 12" x 1/8" thick "Excelon SDT" tile (through-pattern) as manufactured by Armstrong World Industries, or comparable product by Roppe, Flexco, Forbo Flooring, or approved equal, color as scheduled.

1. Product shall meet or exceed the following performance criteria:

a. Critical Radiant Flux: ASTM E 648, Class 1, 0.45 or more watts/cm^2.
b. Smoke Developed: 450 or less per ASTM E 662.
c. Static Load Limit: 75 psi per ASTM F 970.
d. Static Generation: ESD STM 97.2 at 40% R.H. <10 volts; at 12% R.H. <100 volts.
e. Electrical Resistance: ESD-STM-S7.1 and ASTM F 150 10e6 to 10e9 ohms.
f. Static Decay: Fed. Test 101c, Method 4046 (5000 volts to zero) in <0.5 seconds.

C. Colors: As selected by the Architect from manufacturer's full range, to be confirmed through the submittal process.

2.2 ACCESSORIES

A. Concrete Slab Primer: Non-staining type recommended by the tile manufacturer.

B. Leveling Compound: Latex/Portland cement flash patching and leveling compound as provided or approved by the flooring manufacturer for application indicated.

C. Static-Control Adhesive: Adhesive product of the flooring manufacturer that produces conductive continuity of floor covering system. Provide copper ground-connection strips for under the tile as recommended by the flooring manufacturer.

D. Edging Strips: 1/8" thick, homogeneous vinyl composition, tapered or bullnose edge, color as selected by the Architect.

E. Maintenance Tiles: Tiles inscribed "Conductive floor. Do not wax."

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where static-control resilient flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels (Floors): ± 1/8" in 10'-0" distance and 1/4" total maximum variation from levels shown.

B. Grind or fill concrete substrates as required to comply with allowable variation.

3.3 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.
b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.4 INSTALLATION

A. Install tile only after all finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by tile manufacturer.

B. Embed grounding strips in static-control adhesive. Extend strips beyond perimeter of static-control resilient floor covering surfaces to ground points.

C. Place tile units in static-control adhesive in strict compliance with the manufacturer's recommendations. Butt tile units tightly to vertical surfaces, thresholds, nosings and edgings. Scribe around obstructions and to produce neat joints, laid tight, even and in straight, parallel lines. Extend tile units into toe spaces, door reveals, and into closet and similar openings.

D. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on the finish tile as marked in the subfloor. Use chalk or other non-permanent marking devices.

E. Lay tile from center marks established with principal walls, discounting minor off-sets, so that tile at opposite edges of the room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown.

F. Match tiles for color and pattern by using tile from cartons in the same sequence as manufactured and packaged. Cut tile neatly to and around all fixtures. Broken, cracked, chipped, or deformed tile is not acceptable.

G. Tightly adhere tile to sub-base without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks through tile, or other surface imperfections.

H. Lay tile with grain in all tile running in the same direction.

I. Place resilient edge strips tightly butted to tile and secure with adhesive. Provide edging strips at all unprotected edges of tile, unless otherwise shown.

3.5 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from tile, using neutral type cleaners as recommended by the tile manufacturer. Protect installed flooring from damage by use of heavy Kraft paper or other covering.

END OF SECTION

SECTION 096566

RESILIENT ATHLETIC FLOORING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient athletic flooring, as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Interlocking recycled rubber tile.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.

2. ASTM D624: Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

3. ASTM D2047: Standard Test Method for Static Coefficient of Friction of Floor Surfaces.

4. ASTM D2240: Standard Test Method for Rubber Property – Durometer Hardness.

5. ASTM E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

6. ASTM F970: Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading.

7. ASTM F2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work and are approved by flooring manufacturer.

1.5 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's technical information and installation instructions for type of resilient flooring required.

B. Samples: Submit samples of resilient flooring in selected color. Provide 12" square samples to illustrate the range of color and pattern variation.

C. Maintenance Instructions: Submit 2 copies of manufacturer's written instructions for recommended maintenance practices for each type of resilient flooring.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Materials must be delivered in manufacturer’s original, unopened, and undamaged containers with identification labels intact.

B. Store material protected from exposure to harmful weather conditions, on a clean, dry, flat surface protected from all possible damage.

C. Recommended environmental conditions for storage is a minimum of 55 deg F.

D. Material should not suffer excessive damage during handling (i.e. edge chipping, excessive warping, etc.)

1.7 JOB CONDITIONS

A. Maintain a stable room and subfloor temperature of 65 to 80 deg F for a period of 48 hours prior, during, and 48 hours after installation.

B. Moisture vapor emission content of the concrete slab must not exceed 3 lbs/1000 ft^2 per 24 hours when using the calcium chloride test per ASTM F 1869.

PART 2 PRODUCTS

2.1 RESILIENT ATHLETIC FLOORING

A. See Architectural Drawings for exact basis of design specifications.

B. Provide 24" x 24" x 1-1/4" thick interlocking recycled rubber tile composed of resilient floor covering with impact-resistant pedestals on the underside, with ADA transition ramp, as manufactured by Pliteq Inc., American Floor Mats, ECORE International, or approved equal; color as selected by the Architect. Refer also to drawings and schedules.

1. Colors and Patterns: As indicated on Drawings or as selected from manufacturer's full range.

C. Provide Subflooring, Isolator Pads, Sound Control Mat as required based on the final product selection.

D. Adhesive: Waterproof, stabilized type, as recommended by the manufacturer for the type of service indicated.

E. Leveling Compound: Latex/Portland cement flash patching and leveling compound equal to No. DSP-520 made by H.B. Fuller, No. 226 with 3701 admixture made by Laticrete, or comparable product made by Mapei, or approved equal.

F. Edging Strips: 1/8" thick, homogeneous vinyl composition, tapered or bullnose edge, color as selected by the Architect.

G. Concrete Slab Primer: Non-staining type as recommended by the sheet flooring manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient athletic flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Subfloors: Prior to start of laying the flooring, broom clean or vacuum all surfaces to be covered.

1. Lightly grind concrete subfloors with a terrazzo grinder to remove any trowel marks or other surface irregularities which will telegraph to the resilient flooring surface. If grinding is not required, acid etch floor with 10 percent muriatic acid as required to remove any curing compound that would interfere with adhesive bond.

2. Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in subfloors.

3. Subfloor shall be level to ±1/8" in 10'-0" distance and 1/4" total maximum variation from level shown.

4. Perform moisture tests on concrete slabs to determine that concrete surfaces are sufficiently cured and are ready to receive flooring installation.

B. Concrete Primer: Apply concrete slab primer if recommended by the flooring manufacturer, prior to application of the adhesive. Apply in compliance with manufacturer's directions.

3.3 INSTALLATION OF FLOORING

A. Install resilient athletic flooring only after all finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by resilient flooring manufacturer.

B. Composition Rubber Flooring Installation: Comply with Manufacturer's Technical Manual for installation procedures and techniques for resilient flooring installation.

C. Flooring shall be installed to a tolerance of 1/8" in 10'-0" run; 1/32" offset at any location.

3.4 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from flooring, using neutral type cleaners as recommended by the flooring manufacturer. Protect installed flooring from damage by use of heavy Kraft paper or other covering.

B. Finishing: After completion of the project and just prior to the final inspection of the work, thoroughly clean flooring.

END OF SECTION

SECTION 096623

THIN-SET EPOXY TERRAZZO

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the thin-set epoxy terrazzo as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Thin set epoxy terrazzo floor.

2. Divider strips, expansion strips, and accessory strips.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Gypsum Drywall - Section 092900.

1.4 QUALITY ASSURANCE

A. Qualification of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work and have a minimum of ten (10) years' experience in this type of floor system and are members in good standing of the National Terrazzo and Mosaic Association (NTMA).

B. Comply with applicable specifications and recommendations of the National Terrazzo and Mosaic Association, Inc. (NTMA).

C. The Installer shall meet with the Architect for a pre-installation meeting prior to commencement of the work. The Architect shall review installation and position of all divider strips prior to installation of terrazzo.

D. Manufacturer shall be a member of NTMA.

E. Mock-Up: Construct 100 sq. ft. mock-up of terrazzo floor and base for Architect's approval. Do not proceed with any other terrazzo work until mock-up is adjusted and approved by the Architect. Approved mock-up may be incorporated into final work and shall become the standard to which all other terrazzo work must conform. Rejected mock-up must be removed completely and the substrate returned to its original condition.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical information and installation instructions for each type of terrazzo, accessory item, and material required.

B. Certifications

1. Submit supplier's/manufacturer's written certification that terrazzo materials meet or exceed specified NTMA properties.

2. Submit supplier's/manufacturer's written certification that the concrete substrates have been tested and that the moisture vapor transmission rate does not exceed the supplier's/manufacturer's recommendations. All tests shall be performed according to ASTM F 1869 "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride Moisture Emissions Test," or ASTM F 2170 "Standard Test Method for Determining Relative Humidity on Concrete Floor Slabs Using In-Situ Probes," or ASTM F 710 "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring (Tramex Meter)."

a. If moisture vapor transmission levels exceed the manufacturer's recommended levels, the Contractor shall submit the terrazzo manufacturer's recommended remediation method for the Architect's approval.

1). Manufacturer and Contractor shall provide to the Owner a three-year Joint and Several Warranty, starting from the date of Substantial Completion, stating that the Moisture Vapor Barrier shall protect the epoxy terrazzo installation from moisture-related blistering or disbondment, and that in the event of any defects related to moisture vapor transmission within the stipulated period, the manufacturer and Contractor shall jointly or severally effect all repairs or replacement necessary to remedy defects. A copy of the warranty shall be submitted to the Architect for approval during submittal process.

2). Contractor shall provide an add alternate with his bid to provide the recommended moisture vapor transmission remediation in the event it is required.

3. Submit manufacturer's written certification that the terrazzo installer is an authorized installer of the manufacturer's epoxy terrazzo system.

C. Shop Drawings: Submit shop drawings showing layout of divider strips, control joint strips, abrasive strips and base and border strips.

1. Submit shop drawings of precast work showing large scale details of jointing and edge conditions and showing elevations and plans for layout of work. Include details of anchorage and other special features required.

D. Samples: Submit twelve (12) inch square samples of each pattern, color and type of terrazzo required, together with minimum twelve (12) inch long samples of each type of accessory item. Submit full set of sample colors for abrasive strips, and, once color is selected, 12" sample of the strip in selected color. Contractor should anticipate multiple submissions as required to obtain color to Architect's satisfaction. All samples must be submitted two (2) of each.

E. Maintenance Instructions: Submit two (2) copies of written instructions for recommended periodic maintenance of terrazzo.

1.6 WARRANTY

A. The Contractor shall furnish a guarantee of the Epoxy Terrazzo Flooring System for a period of three (3) years after installation. The labor and material guarantee shall include loss of bond, blistering and wear-through to the concrete substrate from normal use.

PART 2 PRODUCTS

2.1 MATERIALS

A. See Architectural Drawings for exact basis of design specifications.

B. Manufacturer/System

1. The Epoxy Thin-Set Terrazzo Flooring System shall consist of a primer coat; 100% solids epoxy terrazzo matrix binder mixed with marble fines and #0, #1, and #1 marble chips (as selected by the Architect); 100% solids epoxy terrazzo matrix grout coat; and maintenance sealer. The total system thickness shall be 3/8" nominal.

   a. Subject to compliance with the requirements of this Specification, the following are approved manufacturers:
      1). Sika Flooring, "Sikafloor 195."
      2). General Polymers, "Thin-Set Epoxy Terrazzo #1100."
      3). Key Resins, "Key Epoxy Terrazzo #108."
      4). Or approved equal.

2. Apply Epoxy Thin-Set Terrazzo Flooring System over 40 mils thick Flexible Epoxy Membrane as manufactured by epoxy terrazzo resin manufacturer on all concrete floors to receive epoxy terrazzo as shown on drawings.

C. Epoxy Thin-Set Terrazzo Typical Physical Properties at 73 deg. F.

Fungus and Bacteria Resistance, MIL-F-5250, Sec. 4.4.2.11	Will not support the growth of fungus or bacteria when subjected to mildew and bacteria tests specified in TT-P-34.
Impact Resistance, Sec. 4.7.3	Withstands 16 ft. lbs. without cracking, delamination or chipping.
Indentation, MIL-D3134F, Sec. 4.7.4	Withstands 2,000 psi for 30 min. without indentation.
Resistance to Elevated Temperature, MIL-D-3134F, Sec. 4.7.5	No slip or flow at required temperature of 158 deg. F.
Abrasion Resistance, ASTM D 4060, CS-17 Wheel	0.1 grams lost

Water Absorption, ASTM D 570-98	10% max. (24 hr. immersion)
Bond Strength to Concrete, 7 days	350 psi (100% concrete failure)
Water Immersion, ACI Comm. #403, Bulletin 59-43	
Flammability, ASTM D 635	Self-extinguishing
Critical Radiant Flux, ASTM E 648	0.95 W/cm^2
Compressive Strength, psi, ASTM D 695	10,000 min.
Tensile Strength, psi, ASTM C 307	2,500
Flexural Strength, psi, ASTM C 580	3,000 min
Thermal Coefficient of Expansion, ASTM C 531	20 x 10^{-6} in/in/deg. F.

D. Terrazzo Membrane Typical Physical Properties at 73 deg. F.

Adhesion, psi, ACI 503R	350 (100% concrete failure)
Hardness, Shore D, ASTM D 2240	23
Tensile Strength, psi, ASTM D 412	1050
Elongation, ASTM D 412	125%
Thermal Cycling, ASTM C 884	No cracking (24 hr., -21 deg. C. to 225 deg. C.)
Flammability, ASTM D 635	Self-extinguishing over concrete
Heat Aging, Exposure to 140 deg. F for:	
2 days	No change in elongation
30 days	No change in elongation
Primary Glass Transition, deg. F	70 to 80
Lower Glass Transition, deg. F	-13 to -22
VOC	Zero

The epoxy elastomer must be free of solvent, external plasticizers, coal tar, known carcinogens, rubber compounds or nitrile butadienes.

E. Accessory Materials

1. Divider Strips: Depth and style as required for type and thickness of terrazzo.

    a. Provide exposed top in widths as indicated on drawings unless otherwise indicated. Comply with NTMA recommendations.
    b. Material shall be "White" metal, zinc or aluminum per NTMA standards.
    c. Space strips in patterns shown on drawings.
    d. Divider strip adhesive shall be mixture of fine sand and bonding agent, specially compounded by manufacturer for this use.

2. Control or Expansion Strips: Double or split units, 1/8" wide, of same materials and color as the divider strips. Provide epoxy terrazzo manufacturer's recommended flexible joint filler in color to match terrazzo formulation.

3. Accessory Strips: Match width, material and color of divider strips. Provide the following accessory strips as required for a complete installation:

    a. Base beads.
    b. Cove base dividers.

4. Cleaner: "4505 Best Yet Neutral Cleaner" by General Polymers, or approved equal.

5. Sealer: Colorless, slip- and stain-resistant, non-yellowing, penetrating sealer which will not disturb the color or physical properties of the terrazzo surface. Provide "4401 Terrazzo Wet Look Sealer" by General Polymers, or approved equal. Sealer shall be UL listed for “Slip Resistance” and required to produce a static coefficient of friction (SCOF) applicable to code

6. Leveling Compound: Epoxy base material as recommended by terrazzo flooring manufacturer, applied over properly prepared substrate.

7. Fill: Epoxy base mortar as recommended by terrazzo flooring manufacturer.

2.2 MIXES

A. Matrix color and chip size to match approved samples.

B. Marble Chips

1. Size to conform to NTMA gradation standards.

2. Hardness to conform to ASTM C 241, Ha-10 minimum.

3. 24-hour absorption rate not to exceed 0.75%.

4. Chips shall contain no deleterious or foreign matter.

5. Dust content less than 1% by weight.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where thin-set epoxy terrazzo is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

B. Do not start work of this Section until all HVAC systems and environmental controls are in place and operating.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels: Refer to Section 033000, "Cast-in-Place Concrete," for required tolerances of concrete sub-slab.

B. Grind or fill concrete substrates as required to comply with allowable variations.

3.3 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.

1. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

2. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.

3. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

1. Moisture Testing: Perform tests indicated below.

a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.
1). Perform tests so that each test area does not exceed 200 sq. ft., and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.

b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative-humidity-level measurement.

c. Test Method: Test for moisture content following ASTM F 1869. Proceed with installation only after substrates have a moisture - vapor emission rate of 3 lbs. of water/1000 sq. ft. in 24 hours. Proceed with installation only after substrates pass testing.

D. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.4 INSTALLATION

A. General

1. Comply with NTMA specifications and manufacturer's recommendations for preparation of substrate, installation of metal strips, and for placing, grinding, grouting and finishing.

2. Complete terrazzo installation before the application of other items that might be damaged by this work.

B. Expansion Joints: Where expansion joints are shown, install two (2) divider strips, separated by the joint width shown with removable strips, extending the full depth of the topping and under bed. Do not bridge expansion joints with reinforcement or cross strips.

1. Expansion joints shall not exceed 30'-0" o.c. unless otherwise noted on drawings.

C. Flooring

1. Work shall be done only under optimum conditions as recommended by manufacturing firm and NTMA recommendations. Surfaces over which matrix is to be applied shall be completely dry and thoroughly clean. Atmospheric and substrate temperature shall be sixty (60) degrees F. or above.

a. Moisture testing of concrete slab must be performed following terrazzo manufacturer's recommendations. If slab contains moisture above recommended levels of the terrazzo manufacturer, the Contractor must provide a moisture barrier that can reduce the vapor emissions level to acceptable limits. Manufacturer's representative must submit written conformation to the Architect verifying that the concrete slab has been properly prepared to receive epoxy terrazzo.

2. Apply primer over entire area to receive floor surfacing. Spread uniformly over surfaces using clean rubber squeegee, or clean steel trowels. Do not allow primer to collect in depressions. Porous areas may require double application of primer.

3. Apply flexible epoxy membrane at 40 mils thick over primer.

4. Terrazzo matrix and chips shall be mixed and applied according to manufacturer's instructions.

5. Allow surfacing to set undisturbed for minimum period of twelve (12) hours or until surfaces are hard and sure. Temperatures throughout curing time shall be maintained at minimum of fifty (50) degrees F. It shall be the complete responsibility of the Contractor to protect and maintain system until such cure is attained.

6. Grind using #24-120 grit stone by wet process method utilizing standard terrazzo grinding equipment. Dry grinding using diamond stones is acceptable for rough grind only. Use vacuums adequate to control grinding dust. Finish grind with #120 grit stone or finer as specified.

7. Grout as required using resin as recommended by the manufacturer. Apply grout according to manufacturer's instructions. After curing for a minimum of twelve (12) hours, grind using #120 grit stone using same method and equipment as used for initial grinding operation.

8. After completion of grinding operation, clean floor of all dirt and abrasive particles by washing with a neutral cleaner and mopping down and rinsing with clean water. When floor is perfectly clean and dry, treat surfaces with terrazzo sealer. Do not apply waxes.

9. Finished surfaces shall be approximately 3/8" thick, true to plane and line, and shall conform to the tolerances specified for the concrete substrate; refer to Section 033000 for concrete slab tolerances.

10. Contractor to coordinate location and proper setting of all items to be installed in floor (i.e. drains, electrical outlets, door closers, etc.).

11. Install terrazzo at floor closer pans as required to match adjacent floor. Grind and seal to align with adjacent floor.

3.5 CLEANING AND SEALING

A. Clean and seal terrazzo in accordance with the instructions of the terrazzo sealer manufacturer after installation and finishing operations are completed.

3.6 PROTECTION

A. Protect Contractor shall protect terrazzo flooring from damage until Project completion; any damage that does occur shall be the responsibility of the Contractor to repair or replace to the satisfaction of the Architect.

3.7 MAINTENANCE SEMINAR

A. The manufacturer and installer shall jointly provide a one (1) day seminar to Owner's maintenance staff describing the procedures, methods and materials required to maintain the terrazzo surfaces in excellent condition for the life of the facility. Included in this seminar shall be any hands-on training for maintenance of finish.

END OF SECTION

SECTION 096723

RESINOUS FLOORING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the resinous flooring and base as shown on the drawings.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Floor drains - Division 22.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer or applicator who has specialized in installing flooring types similar to that required for this Project and who is acceptable to manufacturer of primary materials.

B. Single-Source Responsibility: Obtain resinous flooring materials, including primers, resins, hardening agents, and finish or sealing coats, from a single manufacturer.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract instructions and general recommendations for the resinous flooring specified herein.

B. Samples for initial selection purposes in form of manufacturer's color charts showing full range of colors and finishes available.

1. Submit three (3) 2-1/2" x 4" samples of each material specified herein with color from color chart selection designated by the Architect.

C. Material certificates signed by manufacturer certifying that the composition flooring complies with requirements specified herein.

D. Maintenance written instructions for recommended maintenance practices.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels containing brand name and directions for storage and mixing with other components.

B. Store materials to comply with manufacturer's directions to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Comply with resinous flooring manufacturer's directions for maintenance of ambient and substrate temperature, moisture, humidity, ventilation, and other conditions required to execute and protect Work.

1.8 WARRANTY

A. Provide manufacturer's warranty with flashing endorsement, signed by Applicator and authorized representative of manufacturer, and warranting flooring materials against failures resulting from normal exposure for a period of three (3) years.

PART 2 PRODUCTS

2.1 MATERIALS

A. See Architectural Drawings for exact basis of design specifications.

B. Manufacturers: Subject to compliance with requirements, provide resinous flooring system with integral cove base as manufactured by Stonhard, or equal by Crossfield Products, General Polymers, or approved equal.

1. Basis for Project Design: Stonhard "Stonclad G2," 1/4" thick, texture level 1.

C. Product Description: Four-component, trowel-applied, polyurethane mortar flooring system consisting of urethane-urea binder, pigments, graded quartz aggregate, and recycled glass aggregate.

1. Primer: Urethane Primer by Stonhard.

2. Waterproofing: "Stonproof ME7" two-component polyurethane membrane for positive-side waterproofing.

3. Crack Treatment (if required): "Stonproof CT5" or "RH7" with Texture #3.

4. Coating (if required): "Stonkote GS4" two-component epoxy coating with added slip resistance.

5. Integral Cove Base: "Stonclad GS" three-component epoxy mortar for integral cove base.

D. Color: As selected by the Architect.

2.2 SUPPLEMENTAL MATERIALS

A. Flashing, Sheets, Cant Strips and Accessories: Types as recommended by flooring materials manufacturer, supplied for locations indicated and for locations recommended by manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resinous flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Architect.

3.2 PREPARATION

A. Substrate: Perform preparation and cleaning procedures according to flooring manufacturer's instructions for particular substrate conditions involved, and as specified. Provide clean, dry, and neutral substrate for flooring application.

B. Concrete Surfaces: Shot-blast, acid etch or power scarify as required to obtain optimum bond of flooring to concrete. Remove sufficient material to provide a sound surface free of laitance, glaze, efflorescence, and any bond-inhibiting curing compounds or form release agents. Remove grease, oil, and other penetrating contaminants. Repair damaged and deteriorated concrete to acceptable condition. Leave surface free of dust, dirt, laitance, and efflorescence.

C. Materials: Prepare materials according to flooring system manufacturer's instructions.

D. Starting of work implies acceptance of slab.

3.3 APPLICATION

A. General: Apply each component of resinous flooring system according to manufacturer's directions to produce a uniform monolithic flooring surface at the nominal thickness required.

1. Start installation of flooring only in presence of manufacturer's technical representative who must approve (in writing to the Architect) condition of the prepared floor slab.

B. Cove Base: Apply cove base mix to wall surfaces at locations shown to form cove base height of 8" unless otherwise indicated. Follow manufacturer's printed instructions and details including taping, mixing, priming, troweling, sanding, and top-coating of cove base.

3.4 TESTING

A. Test installation for leaks immediately after nominal cure of the completed flooring. Flood each area to a depth of one inch for 24 hours. Repair all leaks and repeat test until no leakage is observable.

3.5 CURING, PROTECTION AND CLEANING

A. Cure resinous flooring materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process. Close application area for a minimum of 24 hours.

END OF SECTION

SECTION 096813

CARPET TILE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor materials, equipment, and services necessary to complete the carpet tile as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Carpet tile.

2. Adhesive.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Firm with not less than five (5) years of experience in installation of commercial carpeting of type, quantity and installation methods similar to work of this Section.

B. General Terminology/ Information Standard: Refer to current edition of "Carpet Specifier's Handbook" by The Carpet and Rug Institute; for definitions of terminology not otherwise defined herein, and for general recommendations and information.

C. Carpet used on Project must be from same dye lot for each carpet type.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's complete technical product data for each type of carpet, cushion and accessory item required.

B. Samples: Submit full size samples of carpet tile and six (6) inches long samples of each type of exposed edge stripping.

C. Certification: Submit manufacturer's certification stating that carpet materials furnished comply with specified requirements.

1. Include listing of mill register numbers for carpet furnished.

2. Include supporting certified laboratory test data indicating that carpet meets or exceeds specified test requirements.

D. Maintenance Data: Submit manufacturer's printed maintenance recommendations, including methods and frequency recommended for maintaining carpet in optimum conditions under anticipated traffic and use conditions.

1.6 EXTRA STOCK

A. Produce and deliver to project at least five (5) percent overrun on calculated yardage. Provide required overrun exclusive of carpet needed for proper installation, waste and usable scraps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver carpeting materials in original mill protective wrapping with mill register numbers and tags attached. Store inside, in well-ventilated area, protected from weather, moisture, and soiling.

1.8 WARRANTY

A. Provide special project warranty, signed by Contractor and Manufacturer (Carpet Mill), agreeing to repair or replace defective materials and workmanship of carpeting work during two (2) year warranty period following substantial completion. Attach copies of product warranty.

PART 2 PRODUCTS

2.1 CARPET TILE

A. See Architectural Drawings for exact basis of design specifications.

B. Provide carpet tile of design and color scheduled on the drawings, or approved equal.

2.2 ACCESSORIES

A. Adhesive for Carpet Tile: Provide release type adhesive as recommended by the carpet tile manufacturer for use with carpet tile specified. Provide adhesive which complies with flame spread rating required for the carpet installation.

B. Miscellaneous Materials: Provide the types of adhesives and tape, and other accessory items recommended by the carpet manufacturer and Installer for the conditions of installation and use.

C. Leveling Compound: Latex/Portland cement flash patching and leveling compound equal to No. DSP-520 made by H.B. Fuller, No. 226 with 3701 admixture made by Laticrete, or comparable product made by Mapei, or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where carpet tile is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PRE-INSTALLATION REQUIREMENTS

A. Floor shall be clean and free of cracks and protrusions. Any gaps or cracks more than 1/16" wide to be filled in with latex leveling compound. Protrusions must be sanded down smooth, the floor cleanly swept and vacuumed if necessary to remove all dust and grit.

B. Floor temperature shall be 65 deg., at least 24 hrs. prior to installation; and 48 hrs. after carpet is installed.

C. Conduct a moisture test. The presence of moisture in the concrete floor will interfere with the curing and subsequent performance of the adhesive. Conduct the test as follows:

1. Drive a concrete nail a half inch into the floor. Then remove the nail.

2. Place a small amount of anhydrous calcium chloride or calcium sulphate crystals over the hole.

3. Cover the crystals and the hole with a piece of flat glass and seal the edges with waterproof tape or putty. Since concrete pourings vary, repeat the test every 1500 sq. ft.

4. Leave in place 72 hrs. Any color change in the crystals indicates the presence of moisture. Do not apply carpet until slab is free of moisture and meets with approval of carpet adhesive manufacturer.

D. Sequence carpeting with other work so as to minimize possibility of damage and soiling of carpet during remainder of construction period.

3.3 INSTALLATION, GENERAL

A. Comply with manufacturer’s instructions and recommendations. Maintain direction of pattern and texture, including lay of pile.

B. Adhere all tiles with a full spread of adhesive. Dry-fit cut tiles and apply adhesive to tile back after tile has been cut.

C. Tiles shall be installed in a monolithic corner to corner manner following arrows printed on back of each tile indicating pile direction. Tiles shall be installed to achieve patterns as directed by the Architect.

D. Vinyl reducer strips shall be used along any necessary open edges so as to maintain the fixed perimeter.

3.4 CLEANING UP

A. Upon completion of the carpeting installation in each area, visually inspect all carpet installed in that area and immediately remove all dirt, soil, and foreign substance from the exposed face; inspect all adjacent surfaces and remove all marks and stains caused by the carpet installation: remove all packaging materials, carpet scraps, and other debris from the carpet installation to the area of the job site set aside for its storage.

3.5 PROTECTION

A. In all areas, provide a temporary non-staining paper pathway in the direction of traffic.

END OF SECTION

SECTION 097200

WALLCOVERING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the wallcovering as shown on the drawings and/or specified herein.

1. Vinyl wallcovering.

1.3 RELATED SECTIONS

A. Gypsum Drywall - Section 092900.

B. Painting and Finishing - Section 099000.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: For actual cutting and installation of wallcovering, use only thoroughly trained and experienced installers completely familiar with the installation recommendations of the manufacturer of the wallcovering used and completely familiar with the requirements of this work.

B. Manufacturer's Recommendations: The installation recommendations of the manufacturer of the wallcovering used, when approved by the Architect, shall be the basis for acceptance or rejection of actual installation methods used in this work.

C. Test Panels: Install three (3) test panels of full usable width, including one corner, in areas designated by the Architect. Replace test panels which are not acceptable to the Architect until satisfactory installation is achieved.

1.5 SUBMITTALS

A. Samples: Before any wallcovering is delivered to the job site, submit to the Architect samples of the full range of colors and patterns of wallcovering available from the selected manufacturer in the quality and type specified. Samples shall be a min. 36" x 36" in size.

B. Manufacturer’s Recommendations: Accompanying the samples, submit to the Architect copies of the manufacturer's current installation recommendations for the material proposed to be furnished and installed under this Section.

C. A Certificate of Compliance shall be furnished indicating conformance to the specification requirements. This requirement may be waived if fabric and adhesive

packages and containers delivered to the job carry labels indicating weight of materials and fire hazard classification.

1.6 MAINTENANCE INSTRUCTION

A. Furnish the Owner with a copy of the fabric manufacturer's maintenance instructions. These instructions shall contain recommended cleaning materials, application methods, and precautions to be followed in the use of cleaning materials which may be detrimental to the surface if improperly applied.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store all wallcovering in undamaged condition as packaged by the manufacturer, with manufacturer's seal and labels intact. Exercise care to prevent damage during delivery, handling and storage. Store all materials flat in a clean, dry area with maintained temperature above 40 deg. F.

1.8 ENVIRONMENTAL CONDITIONS

A. Wallcovering should be installed only when normal temperature and humidity conditions approximate the same conditions that will exist when the building is occupied.

B. Areas to receive wallcovering shall be a constant temperature of 70 deg. F. measured at base elevation and shall be maintained for 72 hrs. before, during and 48 hrs. after the application.

C. Remove wallcovering from its packaging and allow to acclimatize to the area of installation 24 hrs.

1.9 EXTRA WALLCOVERING

A. Deliver to the Owner sizable remnants for future patching purposes. Also furnish to the Owner five (5) yards of each wallcovering used.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. See Architectural Drawings for exact basis of design specifications.

2.2 VINYL WALLCOVERING

A. Provide vinyl wallcovering as selected by the Architect, conforming to ASTM F 793, Category VI, Type III, weight not less than 22 oz. per sq. yd. with min. coating (less fabric) 12 oz. per sq. yd. Material shall comply with the following fire hazard classification as determined by ASTM E84:

1. Flame spread not more than 25.

2. Fuel contributed not more than 15.

3. Smoke developed not more than 25.

B. Provide Class 2 mildew-resistant backing and comply with the requirements of ASTM D1308 for determining stain resistance.

2.3 ACCESSORIES

A. Adhesive: "Sure Grip Plus Mold and Mildew-Proof Commercial Wall Covering Adhesive" as manufactured by The Zinsser Co. Inc., or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where wallcovering is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Remove wallcovering material from its packaging and allow to acclimatize to the area of installation 24 hrs. before application.

B. Remove switch plates, wall plates, and surface-mounted fixtures, where wallcovering is to be applied.

C. Prime and seal substrates in accordance with wallcovering manufacturer's recommendations for the type of substrate materials to be covered.

D. Surfaces to receive wallcovering shall be free from grit, loose particles and surface irregularities and shall meet the minimum requirements established by the wallcovering manufacturer. Fill all cracks and holes in gypsum board with patching compound and sandpaper smooth.

E. Provide tarpaulins, drop cloths and other suitable covers to protect adjacent and underlying surfaces which are likely to be stained, spotted or otherwise marked by wallpaper paste and application operations.

3.3 INSTALLATION

A. Place wallcovering panels consecutively in the order they are cut from rolls, including filling of spaces above or below openings. Hang by reversing alternate strips, except on match patterns.

B. Apply adhesive to back of wallcovering following adhesive manufacturer's instructions, using roller or paste brush. Install seams vertically and plumb, and at least 6" away from any corner; horizontal seams will not be permitted. Place wallcovering continuously over internal and external corners, going 12" beyond outside corners and 6" at inside corners. Overlap seams and double cut to ensure tight closure. Roll, brush or use a broad knife to remove air bubbles, wrinkles, blisters and other defects. Cut wallcovering evenly to the edges of the outlet box or support.

C. Trim selvages as required to assure color uniformity and pattern match at seams.

D. Remove excess adhesive along finished seams using warm water and a clean sponge, and wipe dry.

E. Install wallcovering with an intimate substrate bond, smooth, clean, without wrinkles, gaps and overlaps.

F. Replace removed plates and fixtures to verify cut edges of wallcovering are completely concealed.

G. Verify that pattern and color are as specified. If pattern is not random, examine for repeat in design.

H. Hang smooth, non-match patterns by pasting strips on the wall, overlapping the edges, and "Double-Cutting" through both thicknesses. Use a 0.04" or 0.06" zinc or aluminum strip between wall and strip when cutting, to avoid gouging the wall.

I. Use stiff-bristled brush or flexible board knife to eliminate air pockets and to secure the wallcovering to the wall surface.

J. Fill spaces above and below doors and similar areas in sequence from the roll, not later than when all full-length pieces have been installed.

K. Examine each seam carefully when completed. Trim additional selvage where required to achieve a color and pattern match at seams.

L. Apply wallcovering before the installation of plumbing fixtures, casings, bases and cabinets.

3.4 PROTECTION

A. Protect finished work installed by other trades prior to work under this Section. Replace any work damaged by workmen of this trade without cost to the Owner.

3.5 CLEAN-UP

A. Any hardware, accessories, plates, etc., which are removed during wallcovering installation shall be replaced level and square.

B. All debris resulting from work covered in this Section shall be removed from the building on a daily basis.

END OF SECTION

SECTION 098413

ACOUSTICAL WALL PANELS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the acoustical wall panels as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Sound-absorbing wall panels, fabric-finished.

1.3 RELATED SECTIONS

A. Carpentry - Section 062000.

B. Gypsum Drywall - Section 092900.

1.4 REFERENCES

A. ASTM C 423, Test for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

B. ASTM E 84, Test for Surface Burning Characteristics of Building Materials.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualification: At least 5 years' experience fabricating and installing comparable work, employing skilled mechanics under competent supervision for all phases of the Work.

B. Surface Burning Characteristics (ASTM E84)

1. Flame Spread: 25 maximum.

2. Smoke Developed: 450 maximum.

1.6 SUBMITTALS

A. Product Data: Submit product data sheet, for specified products.

B. Shop Drawings

1. Base drawings on field measurements.

2. Show dimensioned wall elevations with seam and joint locations, cutout sizes and locations, anchor locations, relation to adjacent work; large-scale joint and mounting details, materials type, weight, and thickness, design, color, and other data necessary to fabricate and install work and coordinate work with affected trades.

C. Samples: Two 12" x 12" (minimum) panels in selected finish, showing seam, edge and cutout conditions.

D. Certification

1. Acoustical Performance: Certified reports of acoustical performance tests conducted and/or witnessed by a recognized, independent, testing agency. Tests shall have been done by specified methods or recognized equivalent. Sound absorption tests shall be not more than three years old. Reports on earlier tests are acceptable if it can be established to the Architect's satisfaction, that they are valid indications of compliance with Project requirements.

2. Fire Hazard: Evidence of compliance with regulatory agency and specifications requirements.

E. Cleaning and Maintenance Instructions: Recommendations for Owner maintenance and cleaning per Section 017300 requirements. Identify cleaning/spotting products generically or by trade name.

F. Manufacturer Qualifications: List comparable installations with 3-year (minimum) service histories. Describe installations and give Owner or building manager names and addresses.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer

C. Allow materials to become acclimated to Project conditions before installation if necessary to prevent sag and distortion during service life.

1.8 PROJECT CONDITIONS

A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete, the building is enclosed, and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% minimum RH and 55% maximum RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

PART 2 PRODUCTS

2.1 SOUND-ABSORBING WALL PANELS

A. See Architectural Drawings for exact basis of design specifications.

2.2 GENERAL

A. Fabricate panels to sizes and configurations indicated; attach facing materials to cores to produce installed panels with visible surfaces fully covered and free from waves in fabric weave, wrinkles, sages, blisters, seams, adhesive or other foreign matter.

1. Fabricate back-mounted panels in factory to exact sizes required to fit wall surfaces based on field measurements of completed substrates indicated to receive acoustical wall panels.

2. Where radius corners are indicated, attach facing material so there are no seams or gathering of material.

B. Dimensional Tolerances of Finished Units: Overall height and width of panels, plus or minus 1/16".

C. Sound Absorption Performance: Provide acoustical wall panels with minimum noise reduction coefficients (NRC) indicated, as determined by testing per ASTM C 423 for mounting type specified under individual product requirements.

D. Colors, Textures, and Patterns: Where manufacturer's standard material is indicated, provide acoustical wall panels faced with manufacturer's material complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.

2.3 BACK-MOUNTED ACOUSTICAL WALL PANELS

A. Back-Mounted, Edge-Reinforced, Acoustical Wall Panels: Manufacturer's standard panel construction consisting of facing material laminated to front, edges, and back border of molded glass fiber board core; with edges chemically hardened to reinforce panel perimeter against warpage and damaged; and complying with the following requirements:

1. Core Density: 9 lb./cu. ft.

2. Thickness and NRC: Nominal overall panel thickness of 2" and NRC of not less than 0.95 for Type A (ABPMA No. 4) mounting.

3. Facing Material: As scheduled on the drawings.

4. Panel Size: As indicated.

5. Edge Detail: As indicated.

2.4 ACCESSORIES

A. Back-Mounting Accessories: Manufacturer's standard or recommended accessories for securely mounting panels of type and size indicated to substrates provided, and complying with the following requirements:

1. Mechanically-Mounted, Edge-Reinforced Panels: Metal panel clip and base support bracket system consisting of 2-part panel clips, with one part of each clip mechanically attached to back of panel and the other part to wall substrate, designed to support panels laterally; and base support brackets designed to support full weight of panels; with both designed to allow panel removal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where acoustical wall panels are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. General: Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's printed instructions for installation of panels using type of mounting accessories indicated or, if none indicated, as recommended by manufacturer.

B. Construction Tolerances

1. Variation from Plumb and Level: +/- 1/16".

2. Variation of Joints from Hairline: Not more than 1/16".

C. Anchoring to Drywall: Anchor clips to unreinforced gypsum board with toggle or Molly anchors. Anchor clips to metal drywall framing with tapping sheet metal screws.

D. Panels shall be pressed against wall and slid down engaging "Z" clips into wall brackets.

E. Remove and replace panels that are damaged and are unacceptable to Architect.

3.3 ADJUSTING AND CLEANING

A. Correct non-complying and damaged/defective Work. Replace work that cannot be satisfactorily repaired.

B. Restretch and reinstall sagging and distorted fabric and correct other defects that occurred during normal service.

C. Carefully and thoroughly clean completed work by vacuuming and/or other means. Remove soil, stains, loose threads.

D. Protect work from soiling and other damage.

END OF SECTION

SECTION 099000

PAINTING AND FINISHING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the painting and finishing as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Prime painting unprimed surfaces to be painted under this Section.
2. Painting all items furnished with a prime coat of paint, including touching up of or repairing of abraded, damaged or rusted prime coats applied by others.
3. Painting all ferrous metal (except stainless steel) exposed to view.
4. Painting all galvanized ferrous metals exposed to view.
5. Painting interior concrete block exposed to view.
6. Painting gypsum drywall exposed to view.
7. Painting concrete floors.
8. Sealing concrete floors.
9. Painting of wood exposed to view, except items which are specified to be painted or finished under other Sections of these specifications. Back painting of all wood in contact with concrete, masonry or other moisture areas.
10. Painting pipes, pipe coverings, conduit, ducts, insulation, hangers, supports and other mechanical and electrical items and equipment exposed to view.
11. Painting surfaces above, behind or below grilles, gratings, diffusers, louvers, lighting fixtures, and the like, which are exposed to view through these items.
12. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
13. Painting of any surface not specifically mentioned to be painted herein or on drawings, but for which painting is obviously necessary to complete the job, or work which comes within the intent of these specifications, shall be included as though specified.

1.3 RELATED SECTIONS

A. Shop priming is required on some, but not all of the items scheduled to be field painted. Refer to other Sections of work for complete description.

B. Shop Coat on Machinery and Equipment: Refer to the Sections under which various items of manufactured equipment with factory applied shop prime coats are furnished, including, but not necessarily limited to, the following Sections. All items of equipment furnished with prime coat finish shall be finish painted under this Section.

1. Plumbing - Division 22.

2. Heating, Ventilation and Air Conditioning - Division 23.

C. Wallcovering - Section 097200.

1.4 MATERIALS AND EQUIPMENT NOT TO BE PAINTED

A. Items of equipment furnished with complete factory finish, except for items specified to be given a finish coat under this Section.

B. Factory-finished toilet partitions.

C. Factory-finished acoustical tile.

D. Non-ferrous metals, except for items specified and/or indicated to be painted.

E. Finished hardware, except for hardware that is factory primed.

F. Surfaces not to be painted shall be left completely free of droppings and accidentally applied materials resulting from the work of this Section.

1.5 QUALITY ASSURANCE

A. Job Mock-Up

1. In addition to the samples specified herein to be submitted for approval, apply in the field, at their final location, each type and color of approved paint materials, applied 10 feet wide, floor to ceiling of wall surfaces, before proceeding with the remainder of the work, for approval by the Architect. Paint mock-ups to include door and frame assembly.

2. These applications when approved will establish the quality and workmanship for the work of this Section.

3. Repaint individual areas which are not approved, as determined by the Architect, until approval is received. Assume at least two paint mock-ups of each color and gloss for approval.

B. Qualification of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces.

C. Paint Coordination: Provide finish coats that are compatible with the prime coat paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates.

Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify the Architect in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

D. All paints must conform to the Volatile Organic Compounds (VOC) standards of prevailing codes and ordinances.

1.6 SUBMITTALS

A. Materials List: Before any paint materials are delivered to the job site, submit to the Architect a complete list of all materials proposed to be furnished and installed under this portion of the work. This shall in no way be construed as permitting substitution of materials for those specified or accepted for this work by the Architect.

B. Samples

1. Accompanying the materials list, submit to the Architect copies of the full range of colors available in each of the proposed products.

2. Upon direction of the Architect, prepare and deliver to the Architect two (2) identical sets of samples of each of the selected colors and glosses painted onto 8-1/2" x 11" x 1/4" thick material; whenever possible, the material for samples shall be the same material as that on which the coating will be applied in the work.

C. Manufacturer's Recommendations: In each case where material proposed is not the material specified or specifically described as an acceptable alternate in this Section of these specifications, submit for the Architect's review the current recommended method of application published by the manufacturer of the proposed material.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver all paint materials to the job site in their original unopened containers with all labels intact and legible at time of use.

B. Protection

1. Store only the approved materials at the job site, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.

2. Use all means necessary to ensure the safe storage and use of paint materials and the prompt and safe disposal of waste.

3. Use all means necessary to protect paint materials before, during and after application and to protect the installed work and materials of all other trades.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.8 EXTRA STOCK

A. Upon completion of this portion of the Work, deliver to the Owner an extra stock of paint equaling approximately ten (10) percent of each color and gloss used and each

coating material used, with all such extra stock tightly sealed in clearly labeled containers.

1.9 JOB CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F. and 90 degrees F., unless otherwise permitted by the paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 degrees F. and 95 degrees F. unless otherwise permitted by the paint manufacturer's printed instructions.

C. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds eighty-five (85) percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.

D. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

PART 2 PRODUCTS

2.1 PAINT MANUFACTURERS

A. See Architectural Drawings for exact basis of design specifications.

B. Except as otherwise noted, provide the painting products listed for all required painting made by one of the manufacturers listed in the paint schedule (Section 2.4). These companies are Benjamin Moore, PPG Paint (Glidden Professional), and Sherwin Williams (S-W). Comply with number of coats and required minimum mil thicknesses as specified herein.

2.2 MATERIALS

A. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer and use only to recommended limits.

B. Colors and Glosses: All colors and glosses shall be as selected by the Architect. Certain colors will require paint manufacturer to prepare special factory mixes to match colors selected by the Architect. Color schedule (with gloss) shall be furnished by the Architect.

C. Coloring Pigment: Products of or furnished by the manufacturer of the paint or enamel approved for the work.

D. Linseed Oil: Raw or boiled, as required, of approved manufacture, per ASTM D 234 and D 260, respectively.

E. Turpentine: Pure distilled gum spirits of turpentine, per ASTM D 13.

F. Shellac: Pure gum shellac (white or orange) cut in pure denatured alcohol using not less than four (4) lbs. of gum per gallon of alcohol.

G. Driers, Putty, Spackling Compound, Patching Plaster, etc.: Best quality, of approved manufacture.

H. Heat-Resistant Paint: Where required, use heat resistant paint when applying paint to heating lines and equipment.

2.3 GENERAL STANDARDS

A. The various surfaces shall be painted or finished as specified below in Article 2.4. However, the Architect reserves the right to change the finishes within the range of flat, semi-gloss or gloss, without additional cost to the Owner.

B. All paints, varnishes, enamels, lacquers, stains and similar materials must be delivered in the original containers with the seals unbroken and label intact and with the manufacturer's instructions printed thereon.

C. All painting materials shall bear identifying labels on the containers with the manufacturer's instructions printed thereon.

D. Paint shall not be badly settled, caked or thickened in the container, shall be readily dispersed with a paddle to a smooth consistency and shall have excellent application properties.

E. Paint shall arrive on the job color-mixed except for tinting of under-coats and possible thinning.

F. All thinning and tinting materials shall be as recommended by the manufacturer for the particular material thinned or tinted.

G. It shall be the responsibility of the Contractor to see that all mixed colors match the color selection made by the Architect prior to application of the coating.

2.4 SCHEDULE OF FINISHES

A. High Performance Coating on Exterior Galvanized Ferrous Metals

First Coat:	"Amerlock 600 Epoxy Series by PPG, "Series 1224 " by Tnemec; "Epoxy Mastic Coating V160" by Benjamin Moore Corotech; or "Recoatable Epoxy Primer 867-45" by Sherwin Williams.
Second Coat:	"Pitthane Ultra 95-812 (Gloss)" or "High Build 95-8800 (Semi-Gloss)" by PPG; "Series 1094 (gloss) " or "Series 1095 (semi-gloss) " by Tnemec; "Aliphatic Acrylic Urethane V500 (Gloss)" or "V510 (Semi-Gloss)" by Benjamin Moore Corotech; or "Hi-Solids Urethane B65-300/350" by Sherwin Williams.

B. High Performance Coating on Exterior Non-Galvanized Ferrous Metals

Prime Coat:	"Amercoat 68HS Epoxy Zinc-Rich Primer" by PPG; "Series 94-H_2O Hydro-Zinc" by Tnemec; “Epoxy Mastic Coating V160” by Benjamin Moore; or "Zinc Clad II Plus Inorganic Zinc Rich Coating B69V212" by Sherwin Williams.
Second Coat:	"Amerlock 600 Epoxy" by PPG; "Series 1224" by Tnemec; "Aliphatic Acrylic Urethane V500 (Gloss)" or "V510 (Semi-Gloss)" by Benjamin

Moore Corotech; or "Macropoxy 646 Fast Cure Epoxy B58-600" by Sherwin Williams.

Third Coat: "Pitthane Ultra 95-812 (Gloss)" or "High Build 95-8800 (Semi-Gloss)" by PPG; "Series 1094 (gloss) " or "Series 1095 (semi-gloss) Fluoronar" by Tnemec; "Aliphatic Acrylic Urethane V500 (Gloss)" or "V510 (Semi-Gloss)" by Benjamin Moore Corotech; or "Hi-Solids Polyurethane B65-300/350" by Sherwin Williams.

C. High Performance Mica or Metallic Coatings on Exterior Galvanized Ferrous Metals

First Coat: "Coroflon ADS Intermediate Epoxy Primer 573/574 Series" by PPG Paints.

Second Coat: "BRP Low VOC Satin and Gloss Acrylic Urethane BRP 1501/1580 Series" by PPG Paints.

Apply one full wet coat. Allow to flash 5 to 10 minutes, then follow with a second full wet coat. Additional coats could be necessary to achieve dry film thickness, for complete hiding, or with metallics.

D. High Performance Mica or Metallic Coatings on Exterior Non-Galvanized Ferrous Metals

First Coat: "Amercoat 68HS Epoxy Zinc-Rich Primer" by PPG Paints.

Second Coat: "Coroflon ADS Intermediate Epoxy Primer 573/574 Series" by PPG Paints.

Third Coat: "BRP Low VOC Satin and Gloss Acrylic Urethane BRP 1501/1580 Series" by PPG Paints.

Apply one full wet coat. Allow to flash 5 to 10 minutes, then follow with a second full wet coat. Additional coats could be necessary to achieve dry film thickness, for complete hiding, or with metallics.

E. Interior Ferrous Metal

Satin Finish/Latex

Primer: Benj. Moore Ultra Spec HP Acrylic Metal Primer (HP04)
PPG Pitt Tech Plus DTM Acrylic Primer 4020
Sherwin-Williams Pro-Industrial Pro-Cryl Universal Primer B66-3100 Series

First Coat: Benj. Moore Ultra Spec-HP DTM Acrylic Low Luster (HP25)
PPG Pitt Glaze WB1 Pre-Catalyzed Eggshell Epoxy 16-310
S-W Pro Industrial Acrylic Eg-Shel, B66-660 Series

Second Coat: Benj. Moore Ultra Spec-HP DTM Acrylic Low Luster (HP25)
PPG Pitt Glaze WB1 Pre-Catalyzed Eggshell Epoxy 16-310
S-W Pro Industrial Acrylic Eg-Shel, B66-660 Series

a. Total DFT not less than: 3.9 mils

Semi-Gloss Finish/Latex

Primer: Benj. Moore Ultra Spec-HP Acrylic Metal Primer (HP04)
PPG Devflex 4020 PF DTM Primer/Flat Finish
Sherwin-Williams Pro-Industrial Pro-Cryl Universal Primer B66-3100 Series

First Coat: Benj. Moore Ultra Spec HP DTM Acrylic Semi-Gloss (HP29)
PPG Pitt Glaze WB1 Pre-Catalyzed Semi-Gloss Epoxy 16-510
S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series
Second Coat: Benj. Moore Ultra Spec HP DTM Acrylic Semi-Gloss (HP29)
PPG Pitt Glaze WB1 Pre-Catalyzed Semi-Gloss Epoxy 16-510
S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series
a. Total DFT not less than: 4.0 mils

F. Interior Concrete Block

Flat Finish/Vinyl Acrylic Latex over Filler
Block Filler: Benj. Moore Ultra Spec Masonry Int./Ext. High Build Block Filler (571)
PPG Speedhide HI Fill Latex Block Filler 6-15XI
S-W Pro Industrial Heavy-Duty Block Filler, B42-150
First Coat: Benj. Moore Ultra Spec 500 Interior Flat Latex (N536)
PPG Speedhide Zero Interior Latex Flat 6-4110XI
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-12600 Series
Second Coat: Benj. Moore Ultra Spec 500 Interior Flat Latex (N536)
PPG Speedhide Zero Interior Latex Flat 6-4110XI
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-12600 Series
a. Total DFT not less than: 10.7 mils

Eggshell Finish/Vinyl Acrylic Latex Over Filler
Block Filler: Benj. Moore Ultra Spec Masonry Int./Ext. High Build Block Filler (571)
PPG Speedhide HI Fill Latex Block Filler 6-15XI
S-W Pro Industrial Heavy-Duty Block Filler, B42-150
First Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)
PPG Speedhide Zero Interior Latex Eggshell 6-4310XI
S-W ProMar 200 Zero VOC Interior Latex Eggshell, B20-1900 Series
Second Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)
PPG Speedhide Zero Interior Latex Eggshell 6-4310XI
S-W ProMar 200 Zero VOC Interior Latex Eggshell, B20-1900 Series
a. Total DFT not less than: 10.9 mils

Semi-Gloss Finish/Vinyl Acrylic Latex over Filler
Block Filler: Benj. Moore Ultra Spec Masonry Int./Ext. High Build Block Filler (571)
PPG Speedhide HI Fill Latex Block Filler 6-15XI
S-W Pro Industrial Heavy-Duty Block Filler, B42-150
First Coat: Benj. Moore Ultra Spec 500 Interior Latex Gloss (N540)
PPG Speedhide Zero Interior Semi-Gloss Latex, 6-4510XI Series
S-W ProMar 200 Zero VOC Interior Latex S. Gloss, B31-2600 Series
Second Coat: Benj. Moore Ultra Spec 500 Interior Latex Gloss (N540)
PPG Speedhide Zero Interior Semi-Gloss Latex, 6-4510XI Series
S-W ProMar 200 Zero VOC Interior Latex S. Gloss, B31-2600 Series
a. Total DFT not less than: 10.7 mils

G. Interior Drywall

Flat Finish/Vinyl Acrylic Latex
Primer: Benj. Moore Ultra Spec 500 Interior Latex Primer (N534)
PPG Speedhide Zero Interior Latex Primer 6-4900XI
S-W ProMar 200 Zero VOC Interior Latex Primer, B28-2600

First Coat: Benj. Moore Ultra Spec 500 Latex Flat (N536)
PPG Speedhide Zero Interior Latex Flat 6-4110XI
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series
Second Coat: Benj. Moore Ultra Spec 500 Latex Flat (N536)
PPG Speedhide Zero Interior Latex Flat 6-4110XI
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series
a. Total DFT not less than: 3.6 mils

Eggshell Finish/Vinyl Acrylic Latex
Primer: Benj. Moore Ultra Spec 500 Interior Latex Primer (N534)
PPG Speedhide Zero Interior Latex Primer 6-4900XI
S-W ProMar 200 Zero VOC Interior Latex Primer, B28-2600
First Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)
PPG Speedhide Zero Interior Latex Eggshell 6-4310XI
S-W ProMar 200 Zero VOC Interior Latex Eg-Shell, B20-1900 Series
Second Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)
PPG Speedhide Zero Interior Latex Eggshell 6-4310XI
S-W ProMar 200 Zero VOC Interior Latex Eg-Shell B20-1900 Series
a. Total DFT not less than: 3.8 mils

H. Interior Drywall to Receive Wallcovering

Primer: "Shield Z Mold and Mildew Proof Commercial Wallcovering Primer" made by Zinsser
Moore One Prep Wallpaper Primer WP-3001 by Insl-X
Multi-Purpose Interior/Exterior B51-450 by Sherwin Williams

I. Interior Painted Wood

Satin Finish/Latex
Primer: Benj. Moore Advance Waterborne Int. Alkyd Primer (790)
PPG Seal Grip Interior Primer/Finish 17-951
S-W Multi-Purpose Latex Primer/Sealer B51 Series
First Coat: Benj. Moore Advance Waterborne Int. Alkyd Satin (792)
PPG Speedhide Zero Interior Latex Satin, 6-4410XI
S-W ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-1900 Series
Second Coat: Benj. Moore Advance Waterborne Int. Alkyd Satin (792)
PPG Speedhide Zero Interior Latex Satin, 6-4410XI
S-W ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-1900 Series
a. Total DFT not less than: 4.0 mils

Semi-Gloss Finish/Latex
Primer: Benj. Moore Advance Waterborne Int. Alkyd Primer (790)
PPG Seal Grip Interior Primer/Finish 17-951
S-W Multi-Purpose Latex Primer/Sealer B51 Series
First Coat: Benj. Moore Advance Waterborne Int. Alkyd (793)
PPG Speedhide Zero Interior Semi-Gloss Latex, 6-4510XI
S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 Series
Second Coat: Benj. Moore Advance Waterborne Int. Alkyd (793)
PPG Speedhide Zero Interior Semi-Gloss Latex, 6-4510XI
S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 Series
a. Total DFT not less than: 3.8 mils

J. Concrete Floor Paint

Primer: Corotech V155 Solid Epoxy Pre-Primer
First Coat: Corotech V440 Waterborne Amine Epoxy
Second Coat: Corotech V440 Waterborne Amine Epoxy
Non-Slip Aggregate: Broadcast Corotech V630 Anti-Slip Aggregate

K. Concrete Floor Sealer: "Super Diamond VOX" water-based, low-VOC acrylic sealer, as manufactured by Euclid Chemical Company, or approved equal.

2.5 EXISTING SURFACES TO BE PAINTED

A. Existing surfaces shall be painted in accordance with schedule given in Article 2.4 herein except that first or prime coat may be eliminated where existing paint is sound. Where existing paint must be removed down to base material, provide first or prime coat as specified.

2.6 PIPING AND MECHANICAL EQUIPMENT EXPOSED TO VIEW

A. Paint all exposed piping, conduits, ductwork and mechanical and electrical equipment. Use heat resisting paint when applied to heating lines and equipment. The Contractor is cautioned not to paint or otherwise disturb moving parts in the mechanical systems. Mask or otherwise protect all parts as required to prevent damage.

B. Exposed Uncovered Ductwork, Piping, Hangers and Equipment: Latex Enamel Undercoater and one (1) coat Acrylic Latex Flat.

C. Exposed Covered Piping, Duct Work and Equipment: Primer/Sealer and one (1) coat Acrylic Latex Flat.

D. Panel Boards, Grilles and Exposed Surfaces of Electrical Equipment: Latex Enamel Undercoater and two (2) coats Latex Semi-Gloss.

E. Equipment or Apparatus with Factory-Applied Paint: Refinish any damaged surfaces to match original finish. Do not paint over name plates and labels.

F. All surfaces of insulation and all other work to be painted shall be wiped or washed clean before any painting is started.

G. All conduit, boxes, distribution boxes, light and power panels, hangers, clamps, etc., are included where painting is required.

H. All items of Mechanical and Electrical trades which are furnished painted under their respective Contracts shall be carefully coordinated with the work of this Section so as to leave no doubt as to what items are scheduled to be painted under this Section.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where painting and finishing are to be applied and correct any conditions detrimental to the proper and timely completion of the work. Do

not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 GENERAL WORKMANSHIP REQUIREMENTS

A. Only skilled mechanics shall be employed. Application may be by brush or roller. Spray application only upon acceptance from the Architect in writing.

B. The Contractor shall furnish the Architect a schedule showing when it is expected that the respective coats of paint for the various areas and surfaces will have been completed. This schedule shall be kept current as the job progresses.

C. The Contractor shall protect his work at all times and shall protect all adjacent work and materials by suitable covering or other method during progress of painting and finishing work. Upon completion of the work, Contractor shall remove all paint and varnish spots from floors, glass and other surfaces, and shall remove from the premises all rubbish and accumulated materials of whatever nature not caused by others, and leave all painting and finishing work in clean, orderly, and acceptable condition.

D. Remove and protect hardware, accessories, device plates, lighting fixtures, and factory finished work, and similar items, or provide ample in place protection. Upon completion of each space, carefully replace all removed items by workmen skilled in the trades involved.

E. Remove electrical panel box covers and doors before painting walls. Paint separately and re-install after all paint is dry.

F. All materials shall be applied under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles and excessive roller stipple.

G. Coverage and hide shall be complete. When color, stain, dirt or undercoats show through final coat of paint, the surface shall be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Owner.

H. All coats shall be dry to manufacturer's recommendations before applying succeeding coats.

I. Do not apply paint behind frameless mirrors that use mastic for adhering to wall surface.

3.3 PREPARATION OF SURFACES

A. Existing Surfaces: Clean existing surfaces requiring paint or finishing, remove all loose and flaking paint or finish and sand surface smooth as required to receive new paint or finish. No telegraphing of lines, ridges, flakes, etc., through new surfacing is permitted. Where this occurs, Contractor shall be required to sand smooth and re-finish until surface meets with Architect’s approval.

B. General

1. The Contractor shall be held entirely responsible for the finished appearance and satisfactory completion of painting work. Properly prepare all surfaces to receive

paint, which includes cleaning, sanding, and touching-up of all prime coats applied under other Sections of the work. Broom clean all spaces before painting is started. All surfaces to be painted or finished shall be completely dry, clean and smooth.

2. Perform all preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Metal Surfaces

1. Weld Fluxes: Remove weld fluxes, splatters, and alkali contaminants from metal surfaces in an approved manner and leave surface ready to receive painting.

2. Bare Metal: Thoroughly clean off all foreign matter such as grease, rust, scale and dirt before priming coat is applied. Clean surfaces, where solder flux has been used, with benzene. Clean surfaces by flushing with mineral spirits. For aluminum surfaces, wipe down with an oil free solvent prior to application of any pre-treatment.

   a. Bare metal to receive high performance coating specified herein must be blast cleaned SSPC SP-6 prior to application if field applied primer; coordinate with steel trades furnishing ferrous metals to receive this coating to insure that this cleaning method is followed.

3. Shop Primed Metal: Clean off foreign matter as specified for "Bare Metal." Prime bare, rusted, abraded and marred surfaces with approved primer after proper cleaning of surfaces. Sandpaper all rough surfaces smooth.

4. Galvanized Metal: Prepare surface as per the requirements of ASTM D 6386.

5. Metal Filler: Fill dents, cracks, hollow places, open joints and other irregularities in metal work to be painted with an approved metal filler suitable for the purpose and meeting the requirements of the related Section of work; after setting, sand to a smooth, hard finish, flush with adjoining surface.

D. Gypsum Drywall Surfaces: Scrape off all projections and splatters, spackles all holes or depressions, including taped and spackled joints, sand smooth. Conform to standards established in Section 092900, "Gypsum Drywall."

E. Wood Surfaces: Sand to remove all roughness, loose edges, slivers, or splinters and then brush to remove dust. Wash off grease or dirt with an approved cleaner. Fill all cracks, splits, nail holes, screw holes, and surface defects with putty after the priming coat has been applied. Putty shall be brought up flush with the surface and sanded smooth and touched-up with primer when dry.

F. Block Masonry Surfaces: Thoroughly clean off all grit, grease, dirt, mortar drippings or splatters, and other foreign matter. Remove nibs or projections from masonry surfaces.

Fill cracks, holes or voids not filled under the "Masonry" Section, with Portland cement grout, and bag surface so that it has approximately the same texture as the adjacent masonry surface.

G. Testing for Moisture Content: Contractor shall test all masonry and drywall surfaces for moisture content using a reliable electronic moisture meter. Contractor shall also test latex type fillers for moisture content before application of top coats of paint. Do not apply any paint or sealer to any surface or to latex type filler where the moisture content exceeds seven (7) percent as measured by the electronic moisture meter.

H. Touch-Up: Prime paint all patched portions in addition to all other specified coats.

3.4 MATERIALS PREPARATION

A. Mix and prepare painting materials in strict accordance with the manufacturer’s directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

C. Stir all materials before application to produce a mixture of uniform density, and as required during the application of the materials. Do not stir any film which may form on the surface into the material. Remove the film and, if necessary, strain the material before using.

D. Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are to be applied. Tint undercoats to match the color of the finish coat; provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.5 APPLICATION

A. General

1. Apply paint by brush or roller in accordance with the manufacturer’s directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required.

2. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried. Sand between each enamel or varnish coat application with fine sandpaper or rub surfaces with pumice stone where required to produce an even, smooth surface in accordance with the coating manufacturer’s directions.

3. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. Give special attention to insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.

    a. "Exposed surfaces" is defined as those areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, etc., are in place in areas scheduled to be painted.

5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint, before final installation of equipment.

6. Paint the back sides of access panels, removable or hinged covers to match the exposed surfaces.

7. Finish doors on tops, bottoms, and side edges the same as the faces, unless otherwise indicated.

8. Enamel finish applied to wood or metal shall be sanded with fine sandpaper and then cleaned between coats to produce an even surface.

9. Paste wood filler applied on open grained wood after beginning to flatten, shall be wiped across the grain of the wood, then with a circular motion, to secure a smooth, filled, clean surface with filler remaining in open grain only. After overnight dry, sand surface with the grain until smooth before applying specified coat.

B. Scheduling Painting

1. Apply the first coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

2. Allow sufficient time between successive coatings to permit proper drying. Do not re-coat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Prime Coats: Re-coat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

D. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage.

E. Touching-Up of Factory Finishes: Unless otherwise specified or shown, materials with a factory finish shall not be painted at the project site. To touch up, the Contractor shall use the factory finished material manufacturer's recommended paint materials to repair abraded, chipped, or otherwise defective surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether to be painted or not, against damage by the painting and finishing work. Leave all such work undamaged. Correct any damages by cleaning, repairing or replacing, and repainting, as acceptable to the Architect.

B. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.7 CLEAN UP

A. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

B. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION

SECTION 099600

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the high-performance coatings as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. High-performance coatings on CMU and drywall surfaces, epoxy prime and urethane finish.

1.3 RELATED SECTIONS

A. Painting and Finishing - Section 099000.

1.4 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.

1. Provide 4'-0" x 4'-0" mock-ups of each type of surface.

2. Allow for six (6) colors to be mocked up.

C. Preinstallation Conference: Conduct a preinstallation conference at Project site no later than 14 days prior to the start of the work.

1. Attendees: Installer, installers job superintendent and/or foreman and technical representatives of manufacturers (not sales representatives) as well as ALL sub-contractors involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

2. Agenda: Review methods and procedures related to stone restoration and cleaning including, but not limited to, the following:

a. Contract Documents.
b. Options.
c. Submittals.

d. Construction Schedule: Verify availability of materials, Restoration Specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
e. Materials, material application, sequencing, tolerances, and required clearances.
f. Review of mockups.
g. Possible conflicts.
h. Compatibility problems.
i. Weather limitations.
j. Manufacturer's written recommendations.
k. Warranty requirements.
l. Compatibility of materials.
m. Acceptability of substrates.
n. Space and access limitations.
o. Testing and inspecting requirements.
p. Required performance results.
q. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements.

4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Regulations: Compliance with VOC and environmental regulations.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

C. Extra Stock: Provide 2 unopened gallons of each coating and color used in the project.

PART 2 PRODUCTS

2.1 MATERIALS

A. See Architectural Drawings for exact basis of design specifications.

B. Provide first-line commercial-quality products for all special coating systems.

2.2 INTERIOR SPECIAL COATING SCHEDULE

A. Concrete Masonry Units to Receive High-Performance, Polyamide Epoxy Coating: 1 coat concrete masonry block filler, 2 coats high-performance polyamide epoxy; total dry film thickness not less than 4 mils over block filler.

B. Drywall Surfaces to Receive High Performance Polyamide Epoxy Coating: 2 coats high-performance polyamide epoxy, total dry film thickness not less than 4 mils.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where high-performance coatings are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Inspect surfaces, report unsatisfactory conditions in writing; beginning work means acceptance of substrate.

B. Comply with manufacturer's instructions and recommendations for preparation, priming and coating work. Coordinate with work of other sections.

C. Match approved mock-ups for color, texture, and pattern. Re-coat or remove and replace work which does not match or shows loss of adhesion. Clean up, touch up and protect work.

END OF SECTION

SECTION 101100

VISUAL DISPLAY SURFACES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the visual display surfaces as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Porcelain-on-metal marker boards.
2. Vinyl-impregnated cork tackboards.
3. Frames and trim.

1.3 RELATED SECTIONS

A. Gypsum Drywall - Section 092900.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: For installation of visual display surfaces, use only personnel who are thoroughly trained and experienced in the skills involved and who are completely familiar with the manufacturer's recommended methods of installation.

B. Installation Methods: The recommended installation methods of the manufacturer shall become the basis for acceptance or rejection of actual installation methods used in the work.

C. Manufacturer: Furnish all visual display surfaces by one manufacturer for entire project.

D. No trademarks or labels will be accepted on exposed finished work.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each material and component part, including data substantiating that materials comply with requirements.

B. Shop Drawings: Submit for each type of visual display surface. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, and installation details.

C. Samples: Submit full range of color samples for each type of marker board, trim and accessory required. Provide 12" square samples of sheet materials and 12" lengths of trim members for color verification after selections have been made.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.7 SPECIAL PROJECT WARRANTY

A. Warranty on Porcelain Enamel Face Sheets: Provide written warranty, signed by manufacturer, agreeing to replace, within warranty period of twenty-five (25) years porcelain enamel face sheets that do not retain original writing and erasing qualities, defined to include surfaces which become slick and shiny, or exhibit crazing, cracking or flaking; provide manufacturer's instructions for handling, installing, protecting and maintaining boards have been adhered during the warranty period. Replacement is limited to material replacement only and does not include labor for removal and reinstallation.

PART 2 PRODUCTS

2.1 PORCELAIN-ON-METAL MARKER BOARDS

A. Construction

1. Porcelain enamel steel marker boards, color as selected by Architect; provide "Series 2" marker boards by Claridge, or approved equal. Writing surface shall be furnished in one piece wherever possible; joints, if required, shall be as approved by the Architect.

2. Core to be 7/16" particleboard.

3. Backer sheet to be 0.015" aluminum.

4. Frame shall be 3/4" wide, satin-anodized aluminum.

5. Sizes as shown on drawings; use maximum size available to eliminate seams. Where seams must be used, provide seaming diagram for Architect's acceptance.

2.2 TACKBOARDS

A. Manufacturers: Provide "Series 2" tackboards as manufactured by Claridge Products, or approved equal; 1/4" thick vinyl-impregnated cork tackboards in color selected by the Architect.

B. Construction

1. Provide 1/4" thick fiberboard core.

2. Trim to be extruded aluminum designed for concealed fastenings, clear anodized finish.

2.3 ACCESSORIES

A. Provide clips, anchors and fasteners required for complete installation.

2.4 FABRICATION

A. Assembly: Provide factory-assembled marker board units unless field-assembled units indicated.

B. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.

1. Vertical joints to be butt jointed with concealed joint fasteners. Ensure cleanly finished edges.

2. Joints shall be absolutely flush and level, plumb true with edges finished square and fitted tightly.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where visual display surfaces are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install units in locations and mounting heights as shown on drawings and in accordance with manufacturer's instructions, keeping perimeter lines straight, plumb and level. Provide all grounds, clips, backing materials, adhesives, brackets, anchors, trim and accessories for complete installation.

B. Coordinate job-assembled units with grounds, trim and accessories. Join all parts with neat, precision fit.

3.3 ADJUST AND CLEAN

A. Verify accessories required for each unit properly installed and operating units properly functioning.

B. Clean units in accordance with manufacturer's instructions, breaking in only as recommended.

END OF SECTION

SECTION 101400

SIGNAGE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the signage as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Room identification signs.

2. Interior directional and door signage.

3. Fire egress, floor, and other signs required by Code.

1.3 RELATED SECTIONS

A. Exit signs - Division 26.

1.4 QUALITY ASSURANCE

A. For actual installation of the interior panel signs, use only personnel who are thoroughly familiar with the manufacturer's recommended methods of installation and who are completely trained in the required skills.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.

B. Samples: Submit samples of each sign showing finishes, colors, surface textures and qualities of manufacture and design of each sign component, including graphics.

C. Shop Drawings: Submit shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale details of sign wording and lettering layout. Show anchorage and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 PANEL SIGNS

A. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16" measured diagonally from corner to corner, manufactured from acrylic sheet, unframed. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

B. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, of letters, numbers, and other graphic devices.

C. Tactile Characters: Characters and Grade 2 Braille raised 1/32" above surfaces, in contrasting color.

D. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures, or other characteristics related to appearance, provide colors and surface textures as selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where signage is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install units and components at the locations directed by the Architect, securely mounted with concealed theft-resistant fasteners. Attach to substrates in accordance with the manufacturer's instructions.

B. Install level, plumb, and at the proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace damaged units as directed by the Architect.

END OF SECTION

SECTION 102113

TOILET PARTITIONS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the toilet partitions as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Floor-to-ceiling-anchored, solid-phenolic toilet partitions.

2. Wall-hung, solid phenolic urinal screens.

3. Hardware and accessories.

1.3 RELATED SECTIONS

A. Gypsum Drywall - Section 092900.

B. Ceramic Tiling - Section 093013.

C. Acoustical Panel Ceilings - Section 095113.

D. Toilet Accessories - Section 102813.

1.4 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to fabrication to ensure proper fitting of the work.

B. Inserts and Anchorages: Furnish inserts and anchoring devices which must be built into other work for the installation of toilet partitions and related work. Coordinate delivery with other work to avoid delay.

1.5 SUBMITTALS

A. Shop Drawings: Before any of the materials of this Section are delivered to the job site, submit the following:

1. Room layouts and elevations for all areas, with dimensions based on actual dimensions taken at job site.

2. Materials, finishes, details of construction, gauges of metal, hardware, fastening and anchoring conditions and relation to adjoining constructions.

B. Samples: Submit the following:

1. One 12" x 12" sample of finish for each color indicated.

2. One sample of each type of hardware and fitting item including related fasteners. Include all items listed under 2.2 C. below.

C. Templates: Submit templates to other trades as required for support of toilet partitions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards.

B. Store products indoors in manufacturer's original containers and packaging with labels clearly identifying product name and manufacturer. Protect from damage.

C. Lay cartons flat, with adequate support to ensure flatness and to prevent damage to prefinished surfaces.

D. Do not store where ambient temperature exceeds 120 degrees.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's limits.

B. Do not deliver material or begin installation until building is enclosed, with complete protection from outside weather, and building temperature is maintained at a minimum of 60 degrees F.

1.8 WARRANTY

A. Manufacturer's Standard Warranty: Provide warranty for phenolic material against delamination, breakage, or corrosion for 10 years.

PART 2 PRODUCTS

2.1 TOILET COMPARTMENTS

A. Provide "Black Core Phenolic" floor-to-ceiling-anchored assemblies, minimum component thickness of 1/2", as manufactured by ASI Global Partitions, or comparable product of Scranton Products, or approved equal.

1. Compartment Depth and Width: As indicated on the Drawings.

2. Door Width: 24" minimum; at ADA accessible compartments 36" minimum.

3. Height Above Floor: 6 inches.

4. Door/Panel Height: 72 inches.

5. Pilaster Height: 82 inches.

6. Color: #3074 Pastel Grey.

2.2 URINAL SCREENS

A. Provide wall-mounted urinal screens in through-color phenolic as manufactured by ASI Global Partitions, or approved equal.

1. Screen Panel Size: As indicated on the Drawings.

2. Height Above Floor: 18 inches.

2.3 MATERIALS AND COMPONENTS

A. Doors, Panels, and Pilasters: Phenolic-resin impregnated, wood-based product core with melamine-impregnated decorative surface papers and transparent, protective topcoat; NEMA LD 3 Compact Laminate.

1. Face Sheet Color: As selected by Architect from manufacturer’s standard range.

2. Doors and Pilasters: 3/4" thick.

3. Panels and Screens: 1/2" thick.

B. Finish: Solid phenolic with black core, as selected from manufacturer's standard colors.

C. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, Class B, when tested in accordance with ASTM E84.

D. Fabrication

1. Fabricate toilet compartment components to sizes indicated.

2. Coordinate requirements and provide cutouts for through-partition toilet accessories and solid blocking within panel where required for attachment of toilet accessories.

3. Provide shoes and caps at pilasters and posts to conceal anchorage, supports, and leveling mechanisms.

4. Provide manufacturer's standard corrosion-resistant supports, leveling mechanisms, anchors, and anchoring assemblies for pilasters and posts.

E. Brackets: Continuous type, brushed stainless steel.

F. Door Hardware

1. Hinges: Brushed stainless steel zamac continuous hinge, cam type, swings to closed or partially open position.

2. Latch and Keeper: Brushed chrome-plated zamac surface mount slide latch.

3. Coat Hook: Manufacturer's standard coat hook with rubber bumper; one per compartment, mounted on door.

4. Door Pull: Provide door pull for outswinging doors. Provide on both sides of doors designated as accessible.

5. Door Bumper: Provide rubber-tipped door bumpers at out-swinging doors.

6. Fastening Hardware: Manufacturer's standard Type 304 stainless steel, No. 4 satin finish, with theft-resistant barrel nuts and machine screws.

G. Mounting Brackets: Standard, die-cast Type 304 stainless steel stirrup bracket, No. 4 satin finish, with stainless steel theft-resistant barrel nuts and machine screws of same material and finish.

H. Pilaster Shoes: Type 304 stainless steel, No. 4 satin finish. Minimum 5" high, secured to floor with internal clips.

I. Pilaster Anchors, Floor-to-Ceiling Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

J. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies at posts and walls, with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps)]at posts to conceal anchorage.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where toilet partitions are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Architect.

3.2 INSTALLATION

A. Install work of this Section in a rigid and permanent manner, straight and plumb, with all horizontal lines level.

B. Install panels and doors twelve (12) inches above finished floor, unless otherwise indicated. Toilet compartment doors shall be centered on water closets, unless otherwise indicated.

C. Maintain uniform clearance of approximately 1/2" between pilasters and panels, and 1/2" between pilasters or panels and finished wall.

D. Maintain uniform clearance of 1/4" or less between vertical edges of doors and pilasters.

E. Floor-to-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position

1. Floor: Set pilaster units with anchorages having not less than two (2) inches penetration into structural floor.

2. Ceiling: Bolt pilasters securely to light steel supporting member above ceiling; use steel spacers for ceiling thickness. Secure pilaster shoe to pilaster with 2 screws on back side of pilaster.

3. Level, plumb and tighten installation with devices furnished.

F. Attach panels or pilasters to one another or to wall with 3 brackets at each joining intersection.

G. Carefully and accurately install hardware and fastening devices. Adjust door hardware and leave in perfect working order.

H. Conceal all evidence of drilling, cutting and fitting of wall or ceiling finishes by completed toilet partition work.

I. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

J. Thoroughly clean finished surfaces of all work of this Section at completion of the installation and leave free from any and all imperfections.

END OF SECTION

102116.27 - PHENOLIC-CORE SHOWER AND DRESSING COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid, phenolic-core compartments.
2. Shower receptors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For shower and dressing compartments in locker rooms and equipment room.

1. Include plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: **25** or less.
2. Smoke-Developed Index: 450 or less.

B. Accessibility Standard: Comply with applicable provisions in **ICC A117.1** for shower and dressing compartments designated as accessible.

2.2 PHENOLIC-CORE COMPARTMENTS

A. Configuration: **Shower and dressing compartments** and **as indicated on Drawings**.

B. Enclosure Style: **Floor and ceiling anchored**

C. Panel and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused together during panel manufacture (not separately laminated) and with eased and polished edges. Provide minimum 3/4-inch-thick pilasters and minimum 1/2-inch-thick panels.

D. Door Construction: Match panels; 3/4-inch minimum thickness.

E. Pilaster **Shoes and Sleeves (Caps)**: Formed from stainless steel sheet, not less than 3 inches (76 mm) high, finished to match hardware.

F. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; **clear-anodized aluminum**.

G. Phenolic-Panel Finish:

1. Facing Sheet Finish: **One color and pattern** in each room.
2. Color and Pattern: **As selected by Architect from manufacturer's full range.**

2.3 SHOWER RECEPTORS

A. General: Manufacturer's standard, prefabricated, terrazzo receptor complete with integral drain.

1. Provide each unit with a ramped entrance surface for accessible compartments.
2. Drain Strainer: Manufacturer's standard; removable.
3. Drain Gasket: Manufacturer's standard gasket sized to fit waste pipe.

B. Finish: Manufacturer's standard finish on exposed surfaces, **as selected by Architect from manufacturer's full range** and with slip-resistant floor surface texture.

2.4 ACCESSORIES

A. Door Hardware and Accessories: Manufacturer's standard design, heavy-duty, operating hardware and accessories.

1. Material: **Stainless steel.**
2. Hinges: Manufacturer's standard, **paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees** allowing emergency access by lifting door.
3. Latch and Keeper: Manufacturer's standard, **surface-mounted** latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility **at compartments designated as accessible**.

4. Clothing Hooks: Manufacturer's standard clothing hooks in each dressing compartment**; include one combination hook and rubber-tipped bumper at inswinging doors, sized to prevent door from hitting wall panel or compartment-mounted accessories**.
5. Door Bumper: Manufacturer's standard, rubber-tipped bumper at outswinging doors.
6. Door Pull: Manufacturer's standard unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Headrail with Hooks: Manufacturer's standard, continuous, extruded-aluminum headrail or cap with curtain hooks running in concealed track; with antigrip profile; in manufacturer's standard finish.

C. Curtain: Flame-resistant, **polyester-reinforced vinyl fabric** that is stain resistant, self-sanitizing, antistatic, antimicrobial, and launderable to a temperature of not less than **90 deg F**.

1. Flame Resistance: Passes NFPA 701 tests when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Labeling: Identify fabrics with appropriate markings of applicable testing and inspecting agency.
3. Length: Where curtain extends to a floor surface, size so that bottom hem clears finished floor by not more than 1 inch and not less than 1/2 inch above floor surface. Where curtains extend to a shower-receptor curb, size so that bottom hem hangs above curb line and clears curb line by not more than 1/2 inch.
4. Color and Pattern: As selected by Architect from manufacturer's full range.

D. Soap Holder: **Surface-mounted** seamless **stainless steel** soap dish.

E. Seats: Manufacturer's standard, **panel-mounted** benches.

1. Material: **Stainless steel**
2. Operation: **Folding**.
3. Finish: **As selected by Architect from manufacturer's full range**

F. Anchorages and Fasteners: Manufacturer's standard, exposed fasteners of stainless steel, chrome-plated steel, or solid brass, finished to match the items they are securing; with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications.

2.5 FABRICATION

A. Floor-and-Ceiling-Anchored Compartments: Manufacturer's standard, corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

B. Door Sizes and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard shower and dressing compartments, and 36-inch-wide, outswinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install compartments rigid, straight, level, and plumb. Secure compartments in position with manufacturer's recommended anchoring devices.

1. Clearances for Dressing Compartments: Maximum 1/2 inch between pilasters and panels; 1 inch between panels and walls.

2. Full-Height (Continuous) Brackets for Dressing Compartments: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Curtains: Install curtains to specified length, and verify that they hang vertically without stress points or diagonal folds.

C. Shower Receptors: Install prefabricated shower receptors with drain gasket compression fit to OD of waste pipe.

3.2 ADJUSTING

A. Curtain Adjustment: After hanging curtains, test and adjust each track or rod to produce unencumbered, smooth operation. Steam and dress down curtains as required to produce crease- and wrinkle-free installation. Remove and replace curtains that are stained or soiled or that have stress points or diagonal folds.

B. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102116.17

Specification - Section 10 22 26 (10650) Operable Partitions

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Electrically operated, continuously hinged partitions.
B. Related Sections include the following:
   1. Division 03 Sections for concrete tolerances required.
   2. Division 05 Sections for primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
   3. Division 06 Sections for wood framing & supports, and all blocking at head and jambs as required.
   4. Division 09 Sections for wall and ceiling framing at head and jambs.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 *Standard Practice for Architectural Application and Installation of Operable Partitions.*
D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.
E. Indoor Air Quality: Operable partition, movable wall manufacturer’s non-wood products must meet the SCS Indoor Advantage™ Gold Certification or equivalent. This approval guarantees conformance to indoor air concentrations meeting Indoor Advantage Gold Indoor Air Quality Certified to SCS-105 v4.2-2023 Conforms to ANSI/BIFMA M7.1 and X7.1 and the CDPH/EHLB Standard Method (CA 01350) v1.2-2017 conducted in an independent third-party air quality testing laboratory.

1.4 REFERENCE STANDARDS

A. ASTM International
   1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
   2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   3. ASTM C1036 - Standard Specification for Flat Glass.
   4. ASTM C1048 - Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
   5. ASTM E84 - Surface Burning Characteristics of Building Materials.
   6. ASTM E413 - Classification for Rating Sound Insulation
B. Health Product Declaration Collaborative
   1. Health Product Declaration Open Standard v2.1
C. International Standards Organization
   1. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).

2. ISO 14025:2011-10, Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures.
3. ISO 14040:2009-11, Environmental Management - Life Cycle Assessment - Principles and Framework.
4. ISO 14044:2006-10, Environmental Management - Life Cycle Assessment - Requirements and Guidelines.
5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services.

D. Other Standards
1. ADA – Americans with Disabilities Act.
2. UL 508A – Standard for Industrial Control Panels
3. NFPA 70 – National Electrical Code
4. ANSI Z97.1 - Safety Glazing Materials Used in Buildings.
5. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
6. NEMA LD3 - High Pressure Decorative Laminates.

1.5 SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.
E. Reports: Provide a complete and unedited written sound test report indicating test specimen matches product as submitted.
F. Create spaces that are healthy for occupants.
1. Furnish products and materials with Health Product Declaration (HPD), Manufacturer Inventory, or other material health disclosure documentation. Products without an HPD or other disclosure documentation are not acceptable.

G. Furnish materials that generate the least amount of pollution.
1. Furnish products and materials that have third party verified environmental product declarations (EPD's). Consider products and materials that have optimized environmental performance (reduced life cycle impacts). Products without an EPD or other disclosure documentation are not acceptable.

H. Buy American: Folding door to be manufactured in the United States in compliance with applicable U.S. Federal Trade Commission (FTC) and U.S. Customs Service and Border Protections regulations and be labeled "Made in America".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.7 WARRANTY

A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.

B. Warranty period: Two (2) years.
C. Suspension System Warranty:
   1. Gym: Ten (10) years.
   2. Multipurpose room: Ten (10) years.
   3. Multipurpose Room: Ten (10) years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATION

A. Manufacturer as basis of design or approved equal
   1. Modernfold, Inc.
B. Products: Subject to compliance with the requirements, provide the following product:
   1. Gym: Acousti-Seal Legacy - Electric Panel: Electrically operated continuously hinged operable partition.
   2. Multipurpose room: Acousti-Seal Legacy - Electric Panel: Electrically operated continuously hinged operable partition.
   3. Multipurpose Room: Acousti-Seal Legacy - Electric Panel: Electrically operated continuously hinged operable partition.

2.2 OPERATION

A. Gym: Acousti-Seal Legacy - Electric Panel: Series of continuously hinged flat panels, electrically operated, top supported with operable floor seals.
B. Multipurpose room: Acousti-Seal Legacy - Electric Panel: Series of continuously hinged flat panels, electrically operated, top supported with operable floor seals.
C. Multipurpose Room: Acousti-Seal Legacy - Electric Panel: Series of continuously hinged flat panels, electrically operated, top supported with operable floor seals.
D. Final Closure:
   1. Gym: Side Jamb with overlapping trail panel.
   2. Multipurpose room: Side Jamb with overlapping trail panel.
   3. Multipurpose Room: Side Jamb with overlapping trail panel.
E. Partition shall be operated by:
   1. Gym: Motor unit shall be reversible, continuous duty, and class A insulated. Motor unit shall have NEMA MG 1 service factor, high starting torque, thermal overload protection, and open/drip proof enclosure. Motor assembly shall have wiring compliant with NFPA 70, 24-volt controls, compliant with UL 508A, and speed of 28 feet/minute. The drive unit motor shall be equipped with outboard limit switches to prevent over-extension. A positive chain drive attached to the lead panel shall pull the partition across the opening. Cable, belt, or other friction type drives will not be accepted.
   2. Multipurpose room: Motor unit shall be reversible, continuous duty, and class A insulated. Motor unit shall have NEMA MG 1 service factor, high starting torque, thermal overload protection, and open/drip proof enclosure. Motor assembly shall have wiring compliant with NFPA 70, 24-volt controls, compliant with UL 508A, and speed of 28 feet/minute. The drive unit motor shall be equipped with outboard limit switches to prevent over-extension. A positive chain drive attached to the lead panel shall pull the partition across the opening. Cable, belt, or other friction type drives will not be accepted.
   3. Multipurpose Room: Motor unit shall be reversible, continuous duty, and class A insulated. Motor unit shall have NEMA MG 1 service factor, high starting torque, thermal overload protection, and open/drip proof enclosure. Motor assembly shall have wiring compliant with NFPA 70, 24-volt controls, compliant with UL 508A, and speed of 28 feet/minute. The drive unit motor shall be equipped with outboard limit switches to prevent over-extension. A positive chain drive attached to the lead panel shall pull the partition across the opening. Cable, belt, or other friction type drives will not be accepted.
F. Electric motor shall consist of:

1. Gym: A 208-volt, 3-phase
2. Multipurpose room: A 208-volt, 3-phase
3. Multipurpose Room: A 208-volt, 3-phase

2.3 PANEL CONSTRUCTION

A. Gym: Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
B. Panel skin shall be:
C. Multipurpose room: Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
D. Panel skin shall be:
E. Multipurpose Room: Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
F. Panel skin shall be:
    1. Gym: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
        a. 50 STC
    2. Multipurpose room: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
        a. 50 STC
    3. Multipurpose Room: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
        a. 50 STC
G. Hinges for Panels, Closure Panels, Pass Doors, and Pocket Doors shall be:
    1. Gym: Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
    2. Multipurpose room: Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
    3. Multipurpose Room: Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
H. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.
I. Panel Weights:
    1. Gym: 50 STC - 8 lbs./square foot
    2. Multipurpose room: 50 STC - 8 lbs./square foot
    3. Multipurpose Room: 50 STC - 8 lbs./square foot

2.4 PANEL FINISH

A. Panel finish shall be:
   1. Gym: Reinforced vinyl with woven backing weighing not less than 20 ounces (567 grams) per lineal yard.
   2. Multipurpose room: Reinforced vinyl with woven backing weighing not less than 20 ounces (567 grams) per lineal yard. With Dry Marker Boards 4' High X Width of Panel, both sides.
   3. Multipurpose Room: Reinforced vinyl with woven backing weighing not less than 20 ounces (567 grams) per lineal yard. With Dry Marker Boards 4' High X Width of Panel, both sides.
B. Panel Trim: Exposed panel trim of one consistent color:
   1. Gym: To Be Advised
   2. Multipurpose room: To Be Advised
   3. Multipurpose Room: To Be Advised

2.5 SOUND SEALS

A. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.
B. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.
C. Horizontal bottom floor seals shall be:
   1. Gym: Modernfold Floating Bottom Seal. Floating operable seals provide nominal 3.50 (89mm) operating clearance with an operating range of +.50" (15mm) to -3" (76mm) and shall provide continuous floor contact as panels are positioned without the need for tools or cranks.
   2. Multipurpose room: Modernfold IA2 Bottom seal. Automatic operable seals providing nominal 2-inch (51mm) operating clearance with an operating range of +0.50-inch (13mm) to -1.50-inch (38mm) which automatically drop as panels are positioned, without the need for tools or cranks.
   3. Multipurpose Room: Modernfold IA2 Bottom seal. Automatic operable seals providing nominal 2-inch (51mm) operating clearance with an operating range of +0.50-inch (13mm) to -1.50-inch (38mm) which automatically drop as panels are positioned, without the need for tools or cranks.

2.6 SUSPENSION SYSTEM

A. Gym: #14 Suspension System
   1. Suspension Tracks: Minimum 7-gauge, 0.18-inch (4.57mm) roll formed steel. Static loading of track with brackets at 48-inch (1220mm) centers shall show no failure of track or brackets at 5,000 pounds (2550kg) point loading at mid-span. Track shall be supported by adjustable steel hanger brackets connected to structural support pairs of 0.50-inch (13mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
      a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and pre-painted off-white.
B. Multipurpose room: #14 Suspension System
   1. Suspension Tracks: Minimum 7-gauge, 0.18-inch (4.57mm) roll formed steel. Static loading of track with brackets at 48-inch (1220mm) centers shall show no failure of track or brackets at 5,000 pounds (2550kg) point loading at mid-span. Track shall be supported by adjustable steel hanger brackets connected to structural support pairs of 0.50-inch (13mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
      a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and pre-painted off-white.
C. Multipurpose Room: #14 Suspension System

1. Suspension Tracks: Minimum 7-gauge, 0.18-inch (4.57mm) roll formed steel. Static loading of track with brackets at 48-inch (1220mm) centers shall show no failure of track or brackets at 5,000 pounds (2550kg) point loading at mid-span. Track shall be supported by adjustable steel hanger brackets connected to structural support pairs of 0.50-inch (13mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
    a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and pre-painted off-white.

2.7 OPTIONS

A. (NONE SELECTED)

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer’s written instructions.
B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and Installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION

A. Demonstrate proper operation and maintenance procedures to Owner's representative.
B. Provide Operation and Maintenance Manual to Owner's representative.

SECTION 102600

WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the wall and door protection as shown on the drawings and/or specified herein.

1. Corner guards.

1.3 RELATED SECTIONS

A. Gypsum Drywall - Section 092900.

1.4 QUALITY ASSURANCE

A. Cover materials shall be classified in accordance with ASTM E 84 as to flame spread and smoke development and shall be classified as self-extinguishing in accordance with ASTM D 635.

1.5 SUBMITTALS

A. Samples: Two (2) samples of corner guards, each 12" long.

B. Shop Drawings: Submit shop drawings for corner guards showing all anchorage devices.

PART 2 PRODUCTS

2.1 MATERIALS

A. Corner Guards: Corner guards shall be high-impact, surface-mounted corner guards, size as indicated on the drawings. Guards shall have a 0.080" thick continuous extruded vinyl cover securely locked in place over the concealed retainer. Guards shall be provided with retainers having intermediate supports for the cover; equal to CS Acrovyn SSM-20N as manufactured by Construction Specialties Inc., or comparable product by InPro Corporation, or approved equal.

B. Fasteners: Manufacturer’s standard stainless-steel screws.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where wall and door protection are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install wall protection according to manufacturer's written instructions, level, plumb, and true to line, without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Install wall protection in locations and at mounting heights indicated on Drawings

C. Corner Guards

1. Corner guards shall be surface mounted, using adhesive applied to the gypsum wallboard substrate.

2. Corner guards shall be set in alignment with the corner bead of the gypsum wallboard substrate.

3.3 ADJUST AND CLEAN

A. Clean surfaces promptly after installation, exercising care to avoid damage to surfaces.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

C. Protect wall panels and corner guards from damage until acceptance of work.

END OF SECTION

SECTION 102813

TOILET ACCESSORIES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the toilet accessories as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Mirrors.
2. Grab bars.
3. Additional toilet accessories as scheduled on the drawings.
4. Electric hand dryers.
5. Diaper-changing stations.
6. Underlavatory guards.
7. Shelf and hook strip for Janitor’s Closets.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Gypsum Drywall - Section 092900.

C. Ceramic Tiling - Section 093013.

D. Toilet Partitions - Section 102113.

E. Electrical - Division 26.

1.4 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

B. Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units. Accessories shall be installed at heights in compliance with prevailing Handicapped Code.

C. Products: Unless otherwise noted, provide products of same manufacturer for each type of unit and for units exposed in same areas.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data, catalog cuts and installation instructions for each toilet accessory.

B. Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices in other work.

C. Submit schedule of accessories indicating quantity and location of each item.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver accessories to the site ready for use in the manufacturer's original and unopened containers and packaging, bearing labels as to type or material, manufacturer's name and brand name. Delivered materials shall be identical to approved samples.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 240 or ASTM A 666, Type 304, with polished No. 4 finish, 22 gauge minimum, unless otherwise indicated.

B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Galvanized Steel Sheet: ASTM A 653, G60.

D. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

E. Mirrors: ASTM C 1503, mirror glazing quality, clear glass mirrors, nominal 1/4" thick.

2.2 FASTENING DEVICES

A. Exposed Fasteners: Theft-proof type, chrome plated, or stainless steel; match finishes on which they are being used.

B. Concealed Fasteners: Galvanized (ASTM A 123) or cadmium plated.

C. No exposed fastening devices permitted on exposed frames.

D. For metal stud drywall partitions, provide ten (10) gauge galvanized sheet concealed anchor plates for securing surface mounted accessories.

2.3 FABRICATION

A. General: Stamped names or labels on exposed faces of toilet accessory units are not permitted. Unobtrusive labels on surfaces not exposed to view are acceptable. Where locks are required for a particular type of toilet accessory, provide same keying throughout project. Furnish two keys for each lock.

B. Surface-Mounted Toilet Accessories, General: Fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage.

C. Recessed Toilet Accessories, General: Fabricate units of all welded construction, without mitered corners. Hang doors of access panels with full-length stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

D. Diaper-Changing Table: As manufactured by Koala Kare products, Division of Bobrick; recessed-mounted horizontal unit that opens by folding down from stored position and with child-protection strap. Diaper-changing table shall be engineered to support a minimum of 250 lb. static load when opened.

2.4 ACCESSORY SCHEDULE

A. Refer to drawings.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where toilet accessories are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Accessories that are to be partition mounted shall be closely coordinated with other trades, so that the necessary reinforcing is provided to receive the accessories.

B. Furnish templates and setting drawings and anchor plates required for the proper installation of the accessories at gypsum drywall and masonry partitions. Coordinate the work to assure that base plates and anchoring frames are in the proper position to secure the accessories.

C. Verify by measurements taken at the job site those dimensions affecting the work. Bring field dimensions that are at variance with those on the approved shop drawings to the attention of the Architect. Obtain decision regarding corrective measures before the start of fabrication of items affected.

D. Cooperate in the coordination and scheduling of the work of this Section with the work of other Sections so as not to delay job progress.

3.3 INSTALLATION

A. Install accessories at locations indicated on the drawings, using skilled mechanics, in a plumb, level and secure manner.

B. Concealed anchor assemblies for gypsum drywall partitions shall be securely anchored to metal studs to accommodate accessories. Assemblies shall consist of plates and/or angles tack welded to studs.

C. Secure accessories in place, at their designated locations by means of theft-proof concealed set screws, so as to render removing of the accessory with a screwdriver impossible.

D. Unless otherwise indicated, accessories shall conform to heights from the finished floor as shown on the drawings. Where locations are not indicated, such locations shall be as directed by the Architect.

E. Installed accessories shall operate quietly and smoothly for use intended. Doors and operating hardware shall function without binding or unnecessary friction. Dispenser type accessories shall be keyed alike. Prior to final acceptance, master key and one duplicate key shall be given to Owner’s authorized agent.

F. The Architect shall be the sole judge of workmanship. Workmanship shall be of the highest quality. Open joints, weld marks, poor connections, etc., will not be permitted. The Architect has the right to reject any accessory if he feels the workmanship is below the standards of this project.

G. Grab bars shall be installed so that they can support a three-hundred (300) lb. load for five minutes per ASTM F 446.

3.4 CLEANING AND PROTECTION

A. Upon completion of the installation, clean accessories of dirt, paint and foreign matter.

B. During the installation of accessories and until finally installed and accepted, protect accessories with gummed canvas or other means in order to maintain the accessories in acceptable condition.

C. Replace and/or repair, to the Owner's satisfaction, and at no additional cost to the Owner, installed work that is damaged or defective.

END OF SECTION

SECTION 104416

FIRE EXTINGUISHERS AND CABINETS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the fire extinguishers and cabinets as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Gypsum Drywall - Section 092900.

B. Fire suppression systems - Division 21.

C. Fire hose cabinets and valve cabinets - Division 21.

1.4 QUALITY ASSURANCE

A. Provide portable fire extinguishers, cabinets and accessories by one manufacturer.

B. UL-Listed Products: Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for all portable fire extinguishers required. For fire extinguisher cabinets include roughing-in dimensions, and details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, style and materials. Where color selections by Architect are required, include color charts showing full range of manufacturer's standard colors and designs available.

B. Samples: Submit samples, 6" square, of each required finish. Prepare samples on metal of same gauge as metal to be used in the work. Where normal color variations are to be expected, include 2 or more units in each sample showing the limits of such variations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following:

1. JL Industries.

2. Larsen's Mfg. Co.

3. Potter Roemer.

2.2 EXTINGUISHERS

A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard which comply with requirements of governing authorities.

B. Abbreviations indicated below to identify extinguisher type related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.

C. Multi-Purpose Dry Chemical Type: UL rated 2-A:10-B:C, 5 lb. nominal capacity, in enameled steel container, for Class A, Class B and Class C fires.

2.3 MOUNTING BRACKETS

A. Provide manufacturer's standard bracket designed to prevent accidental dislodgment of extinguisher, of proper size for type and capacity of extinguisher specified, in manufacturer's standard enamel finish; color to match extinguisher.

2.4 CABINETS

A. Type and Style: Fire extinguisher cabinets shall be metal, recessed, with plexiglass panel, sized to fit within the partition or wall depth. Provide fire-rated cabinets within fire-rated partitions.

B. Color: Fire extinguisher cabinets shall be factory pre-finished with baked enamel in the colors selected by the Architect from the standard range of colors of the selected manufacturer.

C. Design is based on "Model G-2409-R1" of Larsen's Mfg. Co. Other manufacturers noted herein may substitute their equivalent cabinet upon acceptance by the Architect.

2.5 IDENTIFICATION

A. Identify fire extinguisher in cabinet with lettering spelling "FIRE EXTINGUISHER" painted on door by silk-screen process. Provide lettering on door as selected by Architect from manufacturer's standard letter sizes, styles, colors and layouts.

B. Identify bracket-mounted extinguishers with red letter decals spelling 'FIRE EXTINGUISHER' applied to wall surface. Letter size, style and location as selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where fire extinguishers and cabinets are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install items included in this Section in locations indicated and at heights to comply with applicable regulations of governing authorities.

1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.

2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

B. Where exact location of cabinets and bracket-mounted fire extinguishers is not indicated, locate as directed by the Architect.

3.3 SERVICE

A. Determine the approximate completion date of the work and then inspect, charge, and tag the fire extinguishers at a date not more than 10 days before or not less than one day before actual completion date of the work.

END OF SECTION

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Welded athletic lockers.
   2. Locker benches.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For metal lockers.

   1. Include plans, elevations, sections, and attachment details.
   2. Include locker identification system and numbering sequence.

C. Samples: For each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
   1. Warranty Period for Welded Metal Lockers: Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers and locker benches indicated to be accessible, comply with applicable provisions in ICC A117.1

2.2 WELDED ATHLETIC LOCKERS

Retain "Perforated Doors" or "Expanded-Metal Doors" Paragraph below.

A. Perforated Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges and latch point (bottom) and right-angle single bend at remaining edges for box lockers.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.

B. Expanded-Metal Doors: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angle frame; with 0.090-inch (2.28-mm) nominal-thickness, steel sheet lock panel backed by 0.060-inch (1.52-mm) nominal-thickness, steel sheet retainer welded to door frame.

C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
2. Backs: 0.048-inch (1.21-mm) nominal thickness.
3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.

D. Unperforated Sides: Fabricated from **0.048-inch** nominal-thickness steel sheet.

E. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet or 0.097-inch (2.45-mm) nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

F. Hinges:
1. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.

G. Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.

a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism.

H. Locks: **Built-in combination locks** Identification Plates: Manufacturer's standard, etched, embossed, or stamped **aluminum** plates, with numbers and letters at least 3/8 inch high.

I. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.

J. Coat Rods: Manufacturer's standard.

K. Legs: **6 inches** high; formed by extending vertical frame members or fabricated from 0.075-inch nominal-thickness steel sheet; welded to bottom of locker.

1. Provide closed front and end bases.

L. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet, with a pitch of approximately 20 degrees.

1. Closures: Vertical-end type.

M. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

N. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

O. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

P. Finish: Baked enamel or powder coat.

1. Color: **As selected by Architect from manufacturer's full range**

2.3 LOCKS

A. Built-in Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.

1. Bolt Operation: **Manually locking deadbolt**

2.4 LOCKER BENCHES

A. Provide bench units with overall assembly height of **17-1/2 inches**

B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick **except provide 20- to 24-inch-wide tops where accessible benches are indicated**.
2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

C. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors.

1. Color: **As selected by Architect from manufacturer's full range**.

D. Materials:

1. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304.
2. Steel Tube: ASTM A500/A500M, cold rolled.

2.5 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
3. Triple-Tier Units: One double-prong ceiling hook.
4. Coat Rods: **As indicated on Drawings** Retain "Knocked-Down Construction" or "Welded Construction" Paragraph below.

D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.

E. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

F. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.

G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

H. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.

I. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

J. Boxed End Panels: Fabricated with 1-inch-wide edge dimension and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

K. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

L. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top **of lockers and to floor**.
3. Anchor back-to-back metal lockers to floor.

B. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.

C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.
4. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

D. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart.

END OF SECTION 105113

SECTION 115213

PROJECTION SCREENS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the projection screens as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Wood backing and trim for recessed screen installation - Section 062000.

B. Electrical wiring, connections, and installation of remote-control switches for electrically operated projection screens - Division 26.

1.4 QUALITY ASSURANCE

A. Provide each type of projection screen as a complete unit produced by a single manufacturer, including necessary mounting brackets, accessories, fittings and fastenings.

1.5 SUBMITTALS

A. Product Data: Submit copies of manufacturer's specifications and installation instructions for each type of projection screen unit.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and ready for screen installation. Protect screens from damage during delivery, handling, storage and installation.

PART 2 PRODUCTS

2.1 ELECTRICALLY-OPERATED, REMOTE-CONTROL SCREENS

A. See Architectural Drawings for exact basis of design specifications.

B. Provide units for recessed ceiling mounting completely housed in a metal-lined wood case, listed by UL and bearing re-examination markers of UL. Mount top of screen fabric to metal roller with roller supported on brackets with self-aligning bearings.

C. Screen Case: Fabricate wood case with metal lined motor compartment, hinged or removable access panel to motor compartment, electrical outlet box, and finished with manufacturer's standard primer coat.

D. Motor Units: Size and capacity recommended by the screen manufacturer. Use instant reversing, gear drive motor with permanently lubricated ball bearings, automatic thermal overload protection, and pre-set limit switches to automatically stop screen in "up" and "down" and "stop" in a box with cover plate for flush wall mounting. Stop action to be positive to prevent coasting.

1. Screen size shall be as indicated on the drawings.

E. Screen Fabric: Manufacturer's standard, flame and mildew-resistant fabric, glass beaded with chemical coating and 2" black masking borders.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where projection screens are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install projection screen units and accessories at locations shown in accordance with manufacturer's instructions. Install level, plumb, secure and at proper height. Coordinate with other trades for securing projection screen units to finished surfaces. Repair or replace damaged units as directed by the Architect.

B. Provide protections for installed units so that they will be in satisfactory operating condition, without damage at completion of project.

END OF SECTION

SECTION 116623

GYMNASIUM EQUIPMENT

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the gymnasium equipment as shown on the drawings and specified herein, including but not limited to the following:

1. Basketball backboards.
2. Volleyball sleeves, stanchions, and net.
3. Wall pads.
4. Scoreboard.
5. Shot clock.

1.3 RELATED SECTIONS

A. Structural Steel - Section 051200.

B. Miscellaneous Metals - Section 055000.

1.4 QUALITY ASSURANCE

A. Manufacturer: Provide units produced by a firm with not less than 5 years of successful experience in the fabrication of athletic equipment.

1.5 SUBMITTALS

A. Product Data: For each type of product.

1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: For gymnasium equipment.

1. Include plans, elevations, sections, details, and attachments to other work.

2. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, attachments to other work, and operational clearances.

3. Include transport and storage accessories for removable equipment.

C. Coordination Drawings: Court layout plans, drawn to scale, and coordinated with floor inserts, game lines, and markers applied to finished flooring.

1.6 MAINTENANCE

A. Provide maintenance and operating manuals for use of Owner's personnel.

B. Provide instruction in maintenance and operating to Owner's personnel.

1.7 WARRANTY

A. Furnish manufacturer's standard lifetime warranty for backboards.

B. Furnish manufacturer's standard 5-year warranty against defects in workmanship or materials for all items furnished under this section.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements of the Contract Documents, provide products manufactured by one of the following, or approved equal:

1. Draper, Inc.

2. Jaypro Sports, Inc.

3. Porter Athletic Equipment Co.

4. Or approved equal.

B. See Architectural Drawings for exact basis of design specifications.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where the gymnasium equipment is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Coordinate as required with other trades to ensure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Install the work of this Section in strict accordance with the original design, the approved Shop Drawings and the manufacturer's recommended installation procedures.

END OF SECTION

SECTION 12 21 24 - MOTORIZED ROLLER SHADE SYSTEM

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Provide electrically operated, sunscreen and blackout roller shades at ALL exterior building windows except as indicated under paragraph 3.6. Work includes local, group and master control systems for shade operation with addressable, encoded, Electronic Drive Units (EDU).

B. Related Sections:
   1. Division 09 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for blocking, installation of shade pockets, closures and related accessories.
   2. Division 09 - Acoustical Ceilings: Coordination with acoustical ceiling systems for blocking, installation of shade pockets, closures and related accessories.
   3. Division 26 - Electrical: Electric service for EDU's, and EDU controls, internal communication, low voltage wiring and data transfer, and connection to the Internet and required.

1.2 SUBMITTALS

A. Bid Submittal: Information Required with Submittal of Bid: In order to evaluate proposals for integrated lighting control and window shade systems, the Architect requires the following information be submitted prior to the award of the system.
   1. Bid proposal shall be accompanied with a document that notes all deviations from these specifications on a line-by-line basis.
   2. Bid shall confirm that roller shade EDU's and all related controls shall be integrated into a compatible control system as specified herein.
   3. Bid shall include separate line items listing the control/interface components required for building automation systems and building management systems (BAS/BMS), daylighting, audiovisual, and/or central integration systems. Roller shade controls manufacturer shall list all components included in their bid and shall include a letter stating that they shall be financially responsible for any change orders and/or back charges required by the BAS/BMS, audiovisual, or lighting control systems contractors to interface with the motorized roller shade system.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
   3. Storage and handling requirements and recommendations.
   4. Mounting details and installation methods.
   5. Typical wiring diagrams including integration of EDU controllers with building management system, audiovisual and lighting control systems as applicable.

C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, power and control wiring diagrams, and relationship to adjacent work.

1. Prepare shop drawings on AutoCAD or Microstation format using base sheets provided electronically by the Architect.
2. Prepare control, wiring diagrams based on, switching and operational requirements provided by the Architect in electronic format.
3. Include one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.
4. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

D. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shade cloth samples and aluminum finish sample as selected. Mark face of material to indicate interior faces.

E. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

F. Warranty: Provide manufacturer's warranty documents as specified in this Section.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section. This includes but is not limited to all required extrusions, accessories, controls and fabricated roller shades or else all stated and published warranties may be void.

B. Installer Qualifications: Engage an installer, which shall assume responsibility for installation of all system components, with the following qualifications.
1. Installer for roller shade system shall be trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing. Where applicable, system components shall be FCC compliant.

E. PVC-Free Shadecloth: Comply with the following.
1. Shadecloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.
2. Environmental Certification: Submit written certification from the manufacturer, including third party evaluation, recycling characteristics, and perpetual use certification as specified below. Initial submittals, which do not include the Environmental Certification, below will be rejected. Materials that are simply 'PVC free' without identifying their inputs shall not qualify as meeting the intent of this specification and shall be rejected.

3. Third Party Evaluation: Provide documentation stating the shade cloth has undergone third party evaluation for all chemical inputs, down to a scale of 100 parts per million, that have been evaluated for human and environmental safety. Identify any and all inputs, which are known to be carcinogenic, mutagenic, teratogenic, reproductively toxic, or endocrine disrupting. Also identify items that are toxic to aquatic systems, contain heavy metals, or organohalogens. The material shall contain no inputs that are known problems to human or environmental health per the above major criteria, except for an input that is required to meet local fire codes.

4. Recycling Characteristics: Provide documentation that the shade cloth can, and is part of a closed loop of perpetual use and not be required to be down cycled, incinerated or otherwise thrown away. Scrap material can be sent back to the mill for reprocessing and recycling into the same quality yarn and woven into new material, without down cycling. Certify that this process is currently underway and will be utilized for this project.
5. Perpetual Use Certification: Certify that at the end of the useful life of the shade cloth, that the material can be sent back to the manufacturer for recapture as part of a closed loop of perpetual use and that the material can and will be reconstituted into new yarn, for weaving into new shade cloth. Provide information on each shade band indicating that the shade band can be sent back to the manufacturer for this purpose.

F. Requirements for Hardware, Controls, and Switches:
1. Roller Shade Hardware, shade fabric, EDU, and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.

G. Mock-Up: Provide a mock-up, if Architect requires, of one roller shade assembly for evaluation of mounting, appearance and accessories.
1. Locate mock-up in window designated by Architect.
2. Do not proceed with remaining work until, mock-up is accepted by Architect.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver components in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Power and control wiring shall be complete and certified, fully operational with uninterrupted communication on the lines and minimal noise certified by a commissioning agent (by others).
1. 485, ICON, Lonmark and Dry Contract Network: Noise on the line not to exceed shade manufacturer’s limits.

1.6 WARRANTY

A. Warranty: Provide manufacturer’s standard warranties, including the following:

1. Motorized Roller Shade Hardware, and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.
2. Roller Shade EDU's and EDU Control Systems: Manufacturer's standard non-depreciating five-year warranty.
3. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to access to the work above 12' Feet AFF, which are the responsibility of others.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. BASIS OF DESIGN: MECHO SHADE SYTEMS OR 'APPROVED EQUAL' (See Contract drawings for full information)

2.2 INTELLIGENT ENCODED ELECTRONIC DRIVE SYSTEM

A. Electronic Drive Unit (EDU):
1. Intelligent Encoded EDU, and Control System: Tubular, asynchronous (non-synchronous) EDU's, with built-in reversible capacitor operating at 120VAC/60Hz, or (230VAC/50Hz) single phase, temperature Class B, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each EDU.
2. Quiet [42 – 46 db] (within 3 feet open air)
3. Conceal EDU's inside shade roller tube.
4. Maximum current draw for each shade EDU of 0.9Amps at 120VAC.
5. Use EDU's rated at the same nominal speed for all shades in the same room.
6. Use EDU's with minimum of 34RPM, that shall not vary due to load / lift capacity.
7. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade EDU and tube assembly.

B. EDU System: (software, two-way communication): Specifications and design are based on the Intelligent EDU Control System, WhisperShade®IQ® System) as manufactured by MechoSystems. Other systems may be acceptable providing all of the following performance capabilities are provided. EDU and control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.
1. EDU shall support two methods of control
   a. Local Dry Contact Control Inputs
      1.) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to the upper and lower limits.
      2.) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to local switch preset positions.
      3.) Shall support configuring the EDU under protected sequences so that a typical user would not change the EDU's setup. At a minimum the configuration should include setting limits, setting custom presets and configuring key modes of operation.
   b. Network Control
      1.) EDU shall be equipped with a bi-directional network communication capability in order to support commanding the operation of large groups of

shades over a common backbone. The network communication card shall be embedded into the tubular EDU assembly.

2. Upper and lower stopping points (operating limits) of shade bands shall be programmed into EDU's using either a hand held removable program module / configurator or a local switch.
3. Alignment Positions: Each EDU shall support a minimum of 133 repeatable and precisely aligned shade positions (including limits and presets).
   a. All shades on the same switch circuit or with the same network group address with the same opening height shall align at each limit or preset (intermediate stopping position) when traveling from any position, up or down.
   b. Shades of differing heights shall have capability for custom, aligned intermediate stop positions when traveling from any position, up or down.
   c. Alignment of shades mechanically aligned on the same EDU shall not exceed +/- 0.125 inches (3.175mm) when commanded to the same alignment position.
   d. Alignment of shades on adjacent EDU's shall not exceed +/- 0.25" inches (6.35mm) when commanded to the same alignment position.
   e. Local Switch Presets: A minimum of 3 customizable preset positions shall be accessible over the local dry contact control inputs and over the network connection.
      1.) Upon setting the limits for the shade EDU these preset positions shall automatically default to 25%, 50% and 57% of the shade travel.
      2.) These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator or local switch shall be capable of customizing the position of these presets.
   f. Network Presets: A minimum of 29 customizable preset positions (including the 3 local switch presets) shall be accessible via network commands.
      1.) Upon setting the limits for the shade EDU these preset positions shall automatically default to the lower limit unless customized elsewhere.
      2.) These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator shall be capable of customizing the position of these presets.

4. Network Control
   a. The system shall have the capability of two-way digital communication with the EDU's over a common backbone.
   b. Each EDU shall possess 8 addresses capable of being employed for various levels of group control. These addresses shall be configurable via a handheld configurator and/or a PC controller. A 9th unique address shall enable the EDU(s) to be independently controlled and configured over the network via a handheld configurator and/or a PC controller.
   c. Low Voltage Communication Network Implementation.
      1.) The low voltage network shall employ a bus topology with daisy chained network connections between nodes over a CAT5 cable (4 UTP) or over a 2 UTP cable employing at least 1 pair at 16 AWG for power and 1 pair at 22 AWG for data.
      2.) The low voltage network (+/- 13VDC) shall be powered by the nodes attached to it. These nodes could be line voltage powered EDU's attached to 120 VAC or 230 VAC. Alternatively, low voltage nodes shall be powered typically by a centralized low voltage power supply. If a CAT5

network cable is employed and the node draws less than 1W then the node may be powered by DC power supplied by an associated line voltage EDU.

3.) Network Capacity: 4000 ft max, 250 nodes max
   (a) The number and size of a centralized DC supply shall vary depending upon the network requirements.

5. Operating Modes
   a. Uniform or Normal Modes of Operation:
      1.) Uniform mode shall allow for shades to only move to defined intermediate stop positions to maintain maximum uniformity and organization.
      2.) Normal Mode shall allow for shades to move to both intermediate stop positions, plus any position desired between the upper and lower limits as set by the installer.

6. Wall Switches:
   a. Shades shall be operated by, 5, 7, or 10-button low voltage standard switches, or programmable intelligent switches [IS]. Standard switch shall be wired to a bus interface and the bus interface will be programmed to transmit an address for the local switch.
   b. Intelligent switches may be installed anywhere on the bus line. Each IS shall be capable of storing one control level address to be broadcast along the bus line.
   c. An address that is transmitted by either a switch or central controller shall be responded to by those EDU's with the same address in their control table.
   d. IS shall provide for interface with other low voltage input devices via a set of dry contact terminals located on the switch.
   e. Standard switch or IS may control an individual, sub-group or group of EDU's in accordance with the address in each EDU.
   f. All local control switches will be installed in AV room or electrical closet. location to be determined by Architect.

2.3 SHADE BANDS

A. Shade Bands: Construction of Railroaded shade band includes the fabric, the enclosed hem weight, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable. Note: Each shade band shall cover a max of three (3) lights of glass without any horizontal seam joints.

1. Concealed Hembar: Shall be continuous extruded aluminum for entire width of shade band and with the following characteristics:
   a. Hembar shall be heat sealed on all sides.
   b. Open ends shall not be accepted.

2. Shade band and Shade Roller Attachment:
   a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
   b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" Spline mounting, without having to remove shade roller from shade brackets.
   c. Mounting Spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.

d. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

2.4 ROLLER SHADE FABRICATION

A. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided Shadecloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.

B. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shade bands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the Shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

C. For railroaded shade bands, provide seams in railroaded multi-width shade bands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shade bands.

D. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shade bands.

E. Blackout shade bands, when used in side channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet (115 mm) on center extending fully into the side channels. Battens shall be concealed in an integrally colored fabric to match the inside and outside colors of the shade band, in accordance with manufacturer's published standards for spacing and requirements.
   1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.

2.5 ROLLER SHADE COMPONENTS

A. Access and Material Requirements:
   1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
   2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
   3. Use only Delran engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester shall not be accepted.

B. Motorized Shade Hardware and Shade Brackets:

1. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade. Plastic components without use of steel angle construction do not meet the intent of this specification and shall not be accepted.
2. Provide shade hardware system that allows for field adjustment of EDU or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
3. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from the EDU axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade EDU (multi-banded shade, subject to manufacturer's design criteria).
4. All bands within a single EDU group shall be aligned within ¼ inch.

2.6 SHADE CLOTH & ROLLER SHADE SCHEDULE

A. Refer to Finish drawings and specifications for Roller schedule and shade cloth. Shade cloth to be selected from manufacturer's standard colors.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 Turn-Key Single-Source Responsibility for Interior Roller Shades: To control the responsibility for performance of the electric roller shade system; assign the design, engineering, and installation of electronic drive roller shade control system, shades, addressable controls, communication interfaces, and any required sensors, switches and low voltage control wiring specified in this Section to the manufacturer of the shade and control system. The Architect will not produce a set of electrical drawings for the installation of control wiring for the electric roller shade control system.

A. General Contractor responsibilities: GC shall…
   1. Provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings and manufacturer's shop drawings.
   2. Coordinate with requirements of subcontractor for this section before inaccessible areas are constructed.
   3. Coordinate requirements of ALSCS before inaccessible areas are constructed.

4. Provide conduit with pull wire in all areas, which might not be accessible to ALSCS due to building design, equipment location or schedule:
5. Coordinate with the main building electrical subcontractor to provide duplex 120 VAC power receptacle in Electric closet for floor/riser Communication Gateways.
6. Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.
7. Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
8. Protect installed product and finished surfaces from damage during all phases of installation including preparation, testing, and cleanup.
9. Be responsible for all other required electrical work including but not limited to roof penetrations, conduits, fireproofing, etc.
10. Provide conduit with pull wire in all areas, which might not be accessible to subcontractor due to building design, equipment location or schedule.

B. Window Covering Subcontractor (WC) responsibilities:
1. Shade Control Subcontractor shall furnish and install shade controllers, interfaces, splitters, coupler, sensors, switches, junction boxes, etc mounted in the ceiling in an accessible location. Locations for all visible devices to be coordinated with Architect. The shade control subcontractor shall inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

2. LINE VOLTAGE WIRING
WC to ROLLER SHADE EDU: The WC shall furnish and install power connection between Shade control system and EDU, and shall be capable of providing single line voltage wire pull for each EDU.

C. SHADE POWER WIRING (WC)
1. Shall furnish and install line voltage Cable from roller shade motor into line voltage side of control system.
2. Shall wire from General Contractor, provided, power junction box to each motor on the shade network.
3. Shall furnish and install a disconnect plug at the end of the power wiring run to each EDU. The disconnect plug must mate with a matching disconnect plug on the motor cable. EDU cable disconnect plug must be prefabricated by the manufacturer to meet UL and ETL systems requirements.

D. INTEGRATION TO 3RD PARTY SYSTEMS
Main Contractor shall coordinate and provide for others to furnish, install or program any interfaces or wiring to integrate 3rd party systems to the roller shade control system as specified herein. Integration to shade control network can be accomplished locally through dry contact closures, or RS-232.

3.4 INSTALLATION OF ROLLER SHADES

A. Contractor Furnish and Install Responsibilities:
1. Window Covering Contractor (WC) shall provide an on site, Project Manager, and shall be present for all related jobsite scheduling meetings.

2. WC shall supervise the roller shade installation, and setting of intermediate stops of all shades to assure the alignment of the shade bands within a single EDU group, which shall not exceed +/- 0.125 inches (3.175mm), and to assure the alignment between EDU groups, which shall not exceed +/- 0.25” inches (6.35mm).
3. WC shall be responsible for field inspection on an area-by- area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop drawings.
4. Verification of Conditions: examine the areas to receive the work and the conditions under which the work would be performed and notify General Contractor and Owner of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected. Commencement of installation shall constitute acceptance of substrate conditions by the installer.
5. WC shall provide accurate to 0.0625” inch (1.5875mm); field measurements for custom shade fabrication on the Roller Shades manufacturers input forms.
6. WC Installer shall install roller shades level, plumb, square, and true according to manufacturer’s written instructions, and as specified here in. Blocking for roller shades installed under the contract of the interior General Contractor shall be installed plumb, level, and fitted to window mullion as per interior architect’s design documents and in accordance with industry standard tolerances. The horizontal surface of the shade pocket shall not be out-of-level more than 0.625” (15.875mm) over 20 linear feet (6.096 meters).
7. Shades shall be located so the shade band is not closer than 2 inches (50 mm) to the interior face of the glass. Allow proper clearances for window operation hardware.
8. Adjust, align and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
9. Installer shall set Upper, Lower and up to 3 intermediate stop positions of all motorized shade bands, and assure alignment in accordance with the above requirements.
10. WC shall certify the operation of all motorized shades and turn over each floor for preliminary acceptance.
11. The WC shall participate and cooperate with the electrical contractor, the window shade manufacturer and the Commissioning agent to verify and certify the installation is in full conformance with the specifications and is fully operational. This work to occur during the commissioning stage and is in addition to preliminary acceptance required for each floor.
12. Clean roller shade surfaces after installation, according to manufacturer’s written instructions.
13. WC shall train Owner’s maintenance personnel to adjust, operate and maintain roller shade systems.
14. Protect installed products until completion of project.
15. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 12 21 24

SECTION 12 24 13 - WINDOW TREATMENTS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the window treatments as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Manually-operated window shades.
2. Field measurements of as-built conditions.
3. Accessories and hardware required for complete installation and operation.

1.3 RELATED SECTIONS

A. Electrical - Division 26.

1.4 QUALITY ASSURANCE

A. Provide assemblies which are complete assemblies produced by one manufacturer, including hardware, accessory items, mounting brackets, and fastenings.

B. Provide materials in colors as selected by the Architect from manufacturer's standard colors.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Shop Drawings: Submit floor layout and elevations, indicating location of all window treatments, mechanism details, type and size of each unit, type and location of controls. Shop drawings must also show seaming of shade fabric. Submit shop drawings showing details of installation and relation to adjoining construction and conditions.

C. Samples: Submit full size sample of each shade type for Architect's acceptance.

D. Mock-Up

1. Install each type of shade assembly on one complete column bay for Architect's acceptance of installation details, workmanship and operation.
2. Approved mock-up shall be used as the standard for installation of work under this Section, and no further installation work shall proceed before Architect's acceptance

of the mock-up.

1.6 WARRANTY

A. Manufacturer's standard non-depreciating 25-year limited warranty covering all hardware, motors, motor control system and shade cloth.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protect shades from damage, soiling and deterioration during transit, storage and handling to, until Owner's acceptance.

PART 2 PRODUCTS

2.1 MANUALLY OPERATED SHADES

A. Basis of Design: Mecho-Shade Corp.; Mechoshade/5 System.

B. OR APPROVED EQUAL

C. Shade system shall be pre-engineered overrunning clutch design that disengages to 90% during the raising and lowering of the shade. The brake can stand a pull force of 40 lb. in the stop position, or sized as required for shade weight, requiring no adjustment. Self-lubricating hub on to which the brake system is mounted includes an articulated brake assembly which ensures smooth, non-jerky operation in raising and lowering the shades. System shall include the following components:

1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing mounting hardware from opening and without requiring end or center supports to be removed.

2. Provide shade hardware that allows for removal and remounting of the shade bands without having to remove the shade tube, drive or operating support brackets.

3. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.

4. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.

5. Provide shade hardware system that allow for operation of multiple shade bands (multi-banded shades) by a single chain operator. Connectors shall be offset to ensure alignment from the first to the last shade band.

6. Provide shade hardware constructed of minimum 1/8" thick plated steel or heavier as required to support 150% of the full weight of each shade.

7. Drive Bracket/ Brake Assembly:

    a. MechoShade Drive Bracket M5, WT Shade SoloMount, or equal by other manufacturers noted herein.
    b. Rollease Acmeda chain driven clutch operating system of self-lubricating, uv

stabilized fiberglass reinforced nylon construction and tempered high carbon steel internal springs, designed for smooth, trouble-free operation, precise control, and uniform aesthetics. Galaxy geared or spring boost counter balance system to achieve < 6 lbs. constant pull forcesDrive Chain: #10 qualified stainless steel chain rated to 90 lb.

c. Minimum Breaking Strength: Nickel plate chain shall not be accepted.

D. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.

1. Hem Pockets and Hem Weights: Fabric hem pocket with RF welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be the same, for all shades within one room.

2. Shade Band and Shade Roller Attachment:

a. Provide extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without deflection. Provide for positive mechanical engagement with drive/ brake mechanism.
b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable/ replaceable with a snap-on/snap-off spline mounting, without having to remove shade roller from shade brackets.
c. Mounting spline shall not require use of adhesives, adhesive tapes, staples and/or rivets.

2.2 SHADE CLOTH

A. Solar Shade Cloth

1. Basis of Design: Refer to Finish Specifications and Schedule of Contract Drawings. Shade cloth selected from manufacturer’s standard colors.

2. Other Acceptable Manufacturers:

a. Rollease Acmeda; Contract Shade Cloth Sierra Sol Mesa
b. Lutron
c. Sol-R-Veil Inc.
d. Draper
e. WT Shade

2.3 FABRICATION

A. The shade and the fabric shall hang flat without buckling or distortion. The edge, when trimmed, shall hang straight without curling or raveling. An unguided roller shade cloth shall roll true and straight, without tracking sideways more than +/- 1/8" in either direction due to warp distortion or weave design. Shades shall fill window openings from head to sill and jamb to jamb.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where window treatments are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION: GENERAL

A. Coordinate with the work of other trades to ensure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Install the work of this Section in strict accordance with the indicated design and the installation recommendations of the manufacturer as approved by the Architect.

C. Upon completion of the installation, put all components through at least ten (10) complete cycles of operation, adjusting as necessary to achieve optimum operation.

3.3 INSTALLATION OF MANUAL ROLLER SHADES

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions and located so shade band is not closer than 2" to interior face of glass. Allow proper clearances for window operation hardware.

B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Clean roller shade surfaces after installation, according to manufacturers written instructions.

3.4 INSTALLATION OF MOTOR OPERATED SHADES

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions and located so shade band is not closer than 2" to interior face of glass. Allow proper clearances for window operation hardware.

B. To control the responsibility for performance of motorized roller shade systems, the Contractor shall assign the engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified in this Section to a single manufacturer and his authorized installer/dealer. The Architect will not produce a set of electrical drawings for the installation of control wiring for the motors, or motor controllers of the motorized roller shades. Power wiring (line voltage or low voltage), shall be provided by the roller shade installer/dealer, in accordance with the requirements provided by the manufacture. Coordinate the following with the roller shade installer/dealer:

1. Contractor shall provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings.

2. Contractor shall coordinate with requirements of roller shade installer/dealer, before inaccessible areas are constructed.

3. Roller shade installer/dealer shall run line voltage as dedicated home runs (of sufficient quantity, in sufficient capacity as required) terminating in junction boxes in locations designated by roller shade dealer.

4. Roller shade installer/dealer shall provide and run all line voltage (from the terminating points) to the motor controllers, wire all roller shade motors to the motor controllers, and provide and run low voltage control wiring from motor controllers to switch/control locations designated by the Architect. All above ceiling and concealed wiring shall be plenum rated, or installed in conduit, as required by the electrical code having jurisdiction.

5. Contractor shall provide conduit with pull wire in all areas, which might not be accessible to roller shade contractor due to building design, equipment location or schedule.

C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

D. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

E. Engage installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.5 PROTECTION AND CLEANING

A. Protect installed units to ensure proper operating condition, without damage or blemishes. Repair or replace damaged units as directed by the Architect.

END OF SECTION

SECTION 124813

FLOOR MATS AND FRAMES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the floor mats and frames as shown on the drawings and specified herein.

1.3 RELATED SECTIONS

A. Concrete recess - Section 033000.

1.4 QUALITY ASSURANCE

A. Manufacturer: Except as otherwise indicated, provide entrance floor mats and accessories by a single manufacturer for entire project.

1.5 SUBMITTALS

A. Product Data: Submit manufacture's specifications and installation instructions or entrance floor mat. Include methods of installation for each type of substrate.

B. Samples: Submit samples for each type and color of exposed entrance floor mat, frame, and accessory required. Provide 12" square samples of mat, including frame.

C. Maintenance Data: Submit manufacturer's printed instructions for cleaning, drying, maintaining, and rehandling of removable entrance mat units.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 MAT ASSEMBLIES

A. See Architectural Drawings for exact basis of design specifications.

1. Floor mat shall be extruded 6105-T5 aluminum alloy with 3/4" deep tread rails joined by an EPDM hinge and cushion to compromise the overall grid length (traffic direction). The hinge shall be complete with perforations between each tread rail for drainage, unless otherwise specified.

    a. Rail Finish: As selected by Architect.
    b. Structural Capacity: Capable of supporting a rolling load of 1000 pounds/wheel (load applied to a solid 5" x 2" wide polyurethane wheel, 1000 passes without damage) without permanent deformation or noticeable deflection.

2. Mat Frame: Provide level base frame, 1" deep recessed frame in 6063-T6 aluminum alloy with a 1/4" wide exposed surface. Black vinyl fillers shall be furnished as required, when standard 1-1/2" tread spacing cannot be maintained. Installer shall use recommended latex screed to ensure level base.

    a. Frame Color: As selected by Architect.

3. Tread Inserts: Carpet as selected by Architect.

    a. Color: As selected by Architect.

B. Accessories: Provide hidden locking devices to prevent warping and rattling. Furnish number of lock downs as recommended by manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where floor mats and frames are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install mat frames integrally with principal pour of concrete floor system. Locate, align and level frame members accurately.

B. Protection: Upon completion of frame installations and concrete work, provide temporary filler of plywood or fiberboard in mat recesses, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and project reaches substantial completion.

C. Delay installation of mats until work on the project reaches substantial completion.

D. Install floor mat in frame and anchor with hidden lock downs.

END OF SECTION

133416 MOTORIZED BLEACHERS

1.1 WORK INCLUDED

A. Manufacture, deliver and install Telescopic Seating Systems in accordance with applicable codes, the following specifications, and approved drawings.

1.2 RELATED WORK BY OTHERS

A. Adequate floor levelness and strength for operation of telescopic seating.
B. Adequate wall strength for attachment and operation of wall attached telescopic seating.
C. Electrical wiring within the building as required for power operated telescopic seating.

1.3 SYSTEM DESCRIPTION

A. Telescopic seating system shall be multiple tiered seating rows comprised of seat and deck components, risers, and supportive understructure.
B. Telescopic seating shall be operable on the telescopic principle, stacking vertically in minimum floor area when not in use.
C. The first moving row, on manual sections, shall be secured with release lever. All other rows shall be mechanically locked, operable only upon unlocking and cycling of first row. Power sections shall be secured with mechanical locks as well as the power system, operable upon activating the pendant control.

1.4 QUALITY ASSURANCE

A. DESIGN LOAD CRITERIA (STRUCTURAL):
International Building Code Standard: Comply with requirements of IBC / ICC 300, Chapter 4 "Standard for Bleachers, Folding and Telescopic Seating and Grandstands Assembly Seating," except where other requirements are indicated by the architect/owner.
B. Partial Loading Requirements: Telescopic seating governed by IBC 2018, ICC-300 2017, NFPA 102 2016 or NFPA 5000 2018 shall all comply with ASCE 2016, Section 4.3.3 Partial Loading.
C. Manufacturer: Company specializing in telescopic seating with a minimum of 25 years' experience in manufacturing telescopic seating.
D. Engineer Qualifications: Manufacturer to employ a registered, licensed Professional Engineer to certify that the equipment to be supplied meets or exceeds the design criteria of this specification.
E. Installation: Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.
F. Product Liability: Certification of insurance coverage of not less than $5,000,000.
G. Welding Processes: To be performed by certified professional welding operators in accordance with American Welding Society – Certified Welding Fabricator, (AWS-CWF), D1,1 "Structural Welding Code-Steel."
H. Product Improvements: Equipment provided shall incorporate manufacturer's design improvements and materials current at time of shipment, provided that such improvements and materials are consistent with the intent of these specifications.

1.5 SUBMITTALS

A. BID SUBMITTALS
   1. Manufacturer's descriptive literature and specifications.
   2. List of deviations from these specifications, if any.
   3. Certification of Insurance.

B. JOB SUBMITTALS
   1. Shop Drawings showing all equipment to be furnished with details of accessories to be supplied including necessary electrical service to be provided by others. All electrical submittals must include U.L. listing number.
   2. Samples of material and color finish as requested by Architect.
   3. Warranty, operation and maintenance instructions to the owner upon completion.
   4. Submit structural calculations and details signed and sealed by a Professional Engineer licensed in the State of New Jersey, show fabrication, sizes of members, connections and anchorage. Where member sizes vary from those shown on drawings due to structural requirements, coordinate with the Architect before fabrication.

1.6 DESIGN CRITERIA

A. Telescopic seating shall be designed to support, in addition to its own weight, and the weight of added accessories, a uniformly distributed live load of not less than 100 lbs. per sq. ft. (4.8 kN per sq. m.) of gross horizontal projection. Seat boards and footrest shall be designed for a live load of not less than 120 lbs. per linear foot (1.751 kN per linear m).

B. Sway force applied to seats shall be 24 lbs. per linear ft. (350 N per linear m.) parallel to the seats and 10 lbs. per linear ft. (146 N per linear m.) perpendicular to the seats. Sway forces shall not be considered simultaneously applied.

C. Railings, posts and sockets designed to withstand the following forces applied separately.

D. Handrails shall be designed and constructed for:
   1. A concentrated load of 200 lbs. (890 N) applied at any point and in any direction.
   2. A uniform load of 50 lbs. per ft. (730 N/m) applied in any direction.
   The concentrated and uniform loading conditions shall not be required to be applied simultaneously.

E. Guards shall be designed and constructed for:
   1. A concentrated load of 200 lbs. (890 N/m) applied at any point and in any direction along the top railing member and; a uniform load of 50 lbs. per ft. (730 N/m) applied horizontally at the required guardrail height and simultaneous uniform load of 100 lbs. per ft. (1460 N/m) applied vertically downward at the top of the guardrail. The concentrated and uniform loading conditions shall not be required to be applied simultaneously.

F. American Institute of Steel Construction (AISC), American Iron and Steel Institute (AISI) and Aluminum Association (AA) design criteria shall be the basis for calculation of member sizes and connections.

G. Wood members shall be designed in accordance with National Forest Products Association, (NFOPA), and National Design Specification for Wood Construction.

1.7 WARRANTY

A. The manufacturer shall warrant all work performed under these specifications to be free of defects for a period of one year.
B. All understructure components shall be warranted for a period of ten years.
C. Any materials found to be defective within this period will be replaced at no cost to the owner. This warranty shall not include replacements required by Acts of God, war, vandalism, flood, fire, calamity or deliberate abuse or misuse of the equipment.

2.1 ACCEPTABLE MANUFACTURERS

A. As Basis of Design or Approved equal, VersaTract Telescopic Seating System as manufactured by Irwin Seating Company - Telescopic Division, Altamont, IL 62411 or equal, subject to prior approval and strict compliance with these specifications.

2.2 MATERIALS

A. Seating Area: per drawings, Floor Attached, Fully retractable, Electrically Operated, with recoverable ADA accessible seating.
B. Dimensions: per drawings

2.3 FABRICATION

A. Understructure System:
    1. Steel supports and rolling frames shall be constructed from formed steel of the size and shape necessary to support the design loads. All support bracing shall begin at Row 2 and be of diagonal or "knee" type for rigidity. Diagonal bracing to be minimum 1 1/2” x 1 1/2" 14-gauge square tubing. Bracing fabricated from open-sided channel, angle iron or flat strap "X" type bracing is unacceptable.
    2. Wheels shall not be less than 5" diameter x 1 3/8" non-marring soft rubber face to protect wood or synthetic floor surfaces. Each operating row shall have a minimum of 6 wheels.
    3. Each fully skirted wheel channel shall be formed 12-gauge steel and continuously in contact with adjacent channels by means of an Integral Alignment System (IAS) and include nylon glides to eliminate any metal to metal contact. The IAS maintains proper alignment between adjacent wheel channels for smooth and consistent operation while eliminating the potential for accidental row separation. Wheel channel alignment systems with metal to metal contact requiring periodic lubrication or that utilizes a guide rod system that can be bent or damaged will not be acceptable.
    4. Each cantilever arm shall be triple-formed 10-gauge steel, securely welded to the post assembly and include a nylon cantilever pad to ensure smooth operation. The cantilever pad shall also provide a firm base when in the occupied position and provide a solid feel when walked on.
    5. Vertical columns shall be high tensile steel structural tube to meet design criteria. Minimum column size to be 2” x 3” 14-gauge structural tube, welded to a 2’ wide wheel channel using 360 degrees of weldment.
    6. Deck support members shall be double formed 14-gauge steel and connect the front nosing and rear riser members. Each deck support shall include a unique dual-purpose roller that provides smooth support during operation. The deck

support roller shall also include a 3/4” wide shoulder that’s encapsulated by the deck support on the row above in order to maintain proper upper alignment while delivering consistent, repeatable operation.

B. Seat Systems:
   1. Infinity Seat: Supply plastic modular 18” individual seats in either 10” or 12” deep models. Seating to be scuff resistant injection molded high density polyethylene plastic.
      10” Infinity Seat to be supplied
      a. Seat modules supplied shall be of a high aesthetic design using multiple textures, style lines and a waterfall front. The rear of the seat shall be slightly curved to eliminate the straight line appearance and include a moderate seat contour and texture to enhance spectator comfort.
      b. Seating design shall be molded to achieve a finished end appearance without the use of end caps. The rear of the seat shall include a smooth wall allowing for the deck to be easily swept clean without obstruction.
      c. Seat heights shall be maintained at a minimum of 16 3/4". Lower seat heights which detour from spectator comfort will not be accepted.
      d. Foot space shall be maximized for spectator comfort and provide a minimum of 22” when measured with a 10” module and 21” with a 12” module.
      e. Each seat to be designed with the capability of using seat numbers and row letters at the aisle locations. Seat numbers to be stylishly designed using a radius corner to enhance the aesthetic value of the seat. Seat numbers and row letters shall be recessed into the seat to protect against any vandalism.
      f. Select seating colors from manufacturer’s 15 standard colors. Custom colors available as an option.
      g. Securely fasten each seat to the nose beam using a 10-gauge formed steel bracket and locking hardware. Adjacent seating shall be interlocked together along the full perimeter eliminating any fore or aft movement or the potential of any pinching hazard.
      h. Seat modules shall be designed to support a uniform load of 600 lbs per seat and a concentrated load of 150 lbs over 4 square inches.

C. Deck System:
   1. Panelam decking shall have a 0.030 (30 thousandths) high density polyethylene overlay, permanently bonded over a structural deck panel meeting all flooring load requirements. Deck panels shall be supported along the front and back edge for maximum rigidity and connected using a tongue and groove splice leaving the deck clean and free of any tripping or cleaning obstructions. Decking shall be secured in place by the encapsulation of the rear riser and mechanical fasteners along the front edge. Panelam to be selected from manufacturer’s standard colors. Finish thickness to be 5/8”.
   1. Nosing: Nosing shall be one piece, formed, 14-gauge steel with a minimum G-60 pre-galvanized finish.

D. Rear Risers:
    1. Rear riser shall be one piece, formed, 14-gauge steel with a minimum G-60 pre-galvanized finish.
E. Finish: For rust resistance in standard conditions all painted surfaces shall be finished in textured Epoxy Powder Coated Semi-Gloss Black.

1.4 ACCESSORIES

A. Aisles at the footrest level shall include non-slip treads on the top front edge.
B. Intermediate aisle steps shall be provided. Steps are permanently attached closed design. Steps shall be constructed from 14 ga. steel, finished in a Black powder coated epoxy, and designed to eliminate any possible toe catch between the top of the intermediate step and the bottom of the nose beam per ADA or other applicable codes. Front step shall be removable and interlock to the front row eliminating any possibility of accidental disengagement, and store on the front row when not in use.
C. Aisle handrails.
    1. Smart Rail EX aisle handrails shall be provided for 28" to 36" row spacing. Aisle railings shall quickly and easily rotate 90 degrees to the locked position and store parallel to the front of the aisle. Railings that require removal from the pocket or the use of tools for storage will not be acceptable. Aisle railings shall be an individual rail design, located on every other row starting at row two (2). Railing to be constructed of 1 1/2" 11 ga. round steel tubing, finished in a textured powder coated epoxy. For safety, railings designed without a full return of the handrail will not be acceptable.
D. Wheel Chair Seating Areas.
    1. Recoverable wheel chair spaces shall be provided at the section joint location or section length as shown on plans. An integral support on row two shall be provided to eliminate structural damage to the understructure during the operation and use of the system. Recoverable seating areas do not require front railings for support.
E. End rails.
    1. End rails of the self-storing type, finished with textured epoxy powder-coated black enamel, shall be provided at the open ends of the group. End rails shall start at row three and be constructed from 1" square tubing to meet all national building codes. Railings with flexible uprights that can be expanded beyond the 4" sphere are not acceptable.
F. End panels of plywood and supports shall be provided to enclose the open ends of the group in the closed position. End panels shall enclose the space between the wall and the back of the self-storing end rails. End panels to be constructed from Panelam or clear coat plywood.
G. Vinyl end curtains shall be provided to limit unauthorized access to the underside of the telescopic system. Curtain to be one piece design shaped to follow the angle of the telescopic unit in the open position and constructed of a sturdy vinyl material with sewn-in grommets for attachment. Color to be selected from manufacturer's standard selection**.**

H. Seat numbers and row letters shall be supplied in a contrasting, but complementary color for easy seat identification. Layout of numbering to be coordinated with the architect/owner.
I. Supply custom graphics.
    1. Supply custom end seat graphics of school logo or mascot at each aisle seat location. Each graphic shall include full digital printing using a 4 color process, and be sized to follow the entire seat profile. Print-ready artwork to be supplied by the architect/owner.
J. Seat level rear filler panels up to 21" deep used to close openings between top row seat and wall. Provide adequate support structure below the closure panel that will allow for spectators to safely stand in this area. Closure panel to match the deck surface.
O. Portable operator handle with tug frames for use in assisting manually operated bleachers shall be supplied. "T" frame handle to allow two operators to open and close bleacher sections from a standing position.

1.5 PROPULSION SYSTEM

A. FRICTION POWER: Integra Drive System (IDS) shall be furnished on each seating group to open and close the telescopic units. Each individual section shall include 2 IDS friction drive systems integrated into the first moving row of understructure to achieve smooth and efficient operation. Operation of the seating shall be accomplished with the use of a walk along pendant control.
    1. Each IDS power system shall include large 6 1/2" diameter friction rollers to develop tractive force adequate to open and close the system. Each roller to include non-marring 1/2" thick rubber covering.
    2. Electrical motors for each section shall be heavy-duty and high efficiency gear reduction motors. The shaft diameter for the gear motor and rollers shall be a minimum of 1" and be connected by a 1" schedule 40 drive shaft.
    3. All roller chain and sprockets used throughout the drive system shall be a minimum of #40 in size. Each drive unit shall be designed to include a safety shroud around the chain and sprocket for overall safety.
    4. The power units shall develop tractive forces adequate to operate the seating units under normal conditions but inadequate to operate should significant obstacles be encountered.
B. Manufacturer shall provide all wiring from power source within bleacher seating including pendant control. Removable pendant control shall be handheld with forward and reverse button, plugging into a single receptacle. Electrical contractor shall provide a 60 HZ power source (as specified below) behind each group of seating. Amperage to be as specified by seating manufacturer depending on the number of power units required. For wall-attached installations, power source to terminate in a surface mounted junction box above floor. For reverse units, power source to terminate in a junction box, flush mounted under first seating row in center of group. Electrical contractor shall perform the connections to the seating equipment at the junction box. All electrical parts and wiring shall be installed in complete accord with the National Electric Code. U.L. Listing FHJU.E479554.

Supply power system with 208/230V, 5 wire 3-phase system.

3.1 REVIEWS AND APPROVALS

A. Shop drawings shall be approved and job site field measurements taken prior to installation and telescopic gym seating shall be installed in conformance therewith.

3.2 INSTALLATION

A. The installation of the telescopic gym seating will be handled directly by the manufacturer or by a factory authorized installation subcontractor qualified to perform the installation function.

3.3 PROTECTION

A. The manufacturer’s representative shall transmit instructions in both operation and maintenance to the owner.
B. Maintenance and operation of the telescopic gym seating shall be the responsibility of the owner or his duly authorized representative, and shall include the following:
    1. During operation of the telescopic gym seating, the opening and closing shall be supervised by responsible personnel who will assure that the operation is in accordance with the manufacturer's instructions.
    2. Only attachments specifically approved by the manufacturer for the specific installation shall be attached to the telescopic gym seating.
    3. An annual inspection and required maintenance of all telescopic gym seating shall be performed to assure safe conditions. At least bi-annually, the inspection shall be performed by a Professional Engineer or factory service personnel.

SECTION 210000 – FIRE PROTECTION SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

B. The requirements of all other sections of Division 21 apply to this section.

1.2 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a 1 year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect – no exceptions.

1.3 DEFINITIONS

A. For a complete list of definitions for this contract refer to the Division 1 specifications.

B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.4 SCOPE OF WORK

A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the fire protection work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:

1. Remove sprinkler piping and heads as required to accommodate demolition and new work as noted on architectural, mechanical, plumbing, and electrical drawings.
2. Provide new piping, sprinkler heads, supports, etc. as needed to have a fully operational sprinkler system upon project completion.
3. Provide all associated control equipment required unless otherwise noted.
4. Providing all necessary permits, approvals, fees, etc.
5. Provide painting of any exposed sprinkler piping. Coordinate with architect for color selection.
6. Provide instructions to the owner as outlined in these Specifications.
7. Provide all cutting and patching as required to perform the work of this contract.
8. Provide all necessary rigging as required to perform the work of this contract.
9. Provide manufacturer startup for all systems specified as outlined in these Specifications.
10. Provide removal of trash and general clean-up.

11. Provide as-built drawings.
12. Provide operation and maintenance manuals.
13. Refer to Architectural Phasing plans and specifications for requirements related to construction phasing and work hours.
14. Completion Date: All Fire Protection work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.

B. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.

C. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the electrical work as indicated, required or implied by the drawings and as specified herein.

D. All of the contract specifications and all of the contract drawings are part of the Contract Documents of the Contractor. The Contractor shall review all drawings and specification divisions to determine the full scope of his work.

E. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Electrical Mechanical, Plumbing and Fire Protection) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

L. WARRANTY

1. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered, or installed, warranties will commence after the Architect issues his letter of “Substantial Completion.”

2. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment; otherwise, final payment will be withheld until the factory reports are submitted.

3 All equipment furnished for this Owner shall include a one-year warranty on parts and labor. This warranty shall supersede all notations in all the other Division 21 specification sections.

PART 3 - EXECUTION

3.1 “FIRE WATCH” SCOPE OF WORK

A. Personnel performing the fire watch shall NOT be performing any other duties that would take their attention away from the areas that are not covered by the fire alarm system.

END OF SECTION 210000

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. Metraflex Company (The).
3. Pipeline Seal and Insulator, Inc.
4. Proco Products, Inc.
5. Or approved equal.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

2. Interior Partitions:

    a. Piping Smaller Than NPS 4: Galvanized-steel-pipe sleeves.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.

c. Insulated Piping: One-piece, stamped-steel type.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

1.2 SYSTEM DESCRIPTIONS AND REQUIREMENTS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. All concealed sprinkler heads caps shall be a specific color as chosen by Architect.

1.3 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

    a. Building Service Areas: Ordinary Hazard, Group 1.
    b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    c. General Storage Areas: Ordinary Hazard, Group 1.
    d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    e. Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:

    a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:

a. Patientl Areas: 400 sq. ft.
b. Office Spaces: 225 sq. ft.
c. Storage Areas: 130 sq. ft.
d. Mechanical Equipment Rooms: 130 sq. ft.
e. Electrical Equipment Rooms: 130 sq. ft.
f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified Installer and professional engineer.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

G. Field quality-control reports.

H. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

D. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Corcoran Piping System Co.
c. National Fittings, Inc.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.
f. Or approved equal.

2. Pressure Rating: 175 psig minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

E. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Victaulic Company.

b. Or approved equal

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.

1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating: 175 psig.

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Metraflex, Inc.
d. NIBCO INC.
e. Reliable Automatic Sprinkler Co., Inc.
f. Tyco Fire & Building Products LP.
g. Victaulic Company.
h. Viking Corporation.
i. Watts Water Technologies, Inc.
j. Or approved equal

2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. American Valve, Inc.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. Mueller Co.; Water Products Division.
g. NIBCO INC.

h. Tyco Fire & Building Products LP.
i. United Brass Works, Inc.
j. Watts Water Technologies, Inc.
k. Or approved equal.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

D. Indicating-Type Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Anvil International, Inc.
b. Global Safety Products, Inc.
c. Kennedy Valve; a division of McWane, Inc.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Tyco Fire & Building Products LP.
g. Victaulic Company.
h. Or approved equal.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:

a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:

a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.; Apollo Valves.
    b. Kennedy Valve; a division of McWane, Inc.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Potter Roemer.
    f. Tyco Fire & Building Products LP.
    g. Victaulic Company.
    h. Watts Water Technologies, Inc.
    i. Or approved equal.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

    a. AFAC Inc.
    b. Globe Fire Sprinkler Corporation.
    c. Reliable Automatic Sprinkler Co., Inc.
    d. Tyco Fire & Building Products LP.
    e. Venus Fire Protection Ltd.
    f. Victaulic Company.
    g. Viking Corporation.
    h. Or approved equal.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFAC Inc.
b. Elkhart Brass Mfg. Company, Inc.
c. GMR International Equipment Corporation.
d. Guardian Fire Equipment, Inc.
e. Potter Roemer.
f. Or approved equal.

2. Standard: UL 405.
3. Type: Flush, for wall mounting. To be approved by the local Fire Company.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 4 or as requested by the local Fire Company..

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. National Fittings, Inc.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.
e. Or approved equal.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkhart Brass Mfg. Company, Inc.
b. Fire-End & Croker Corporation.
c. Potter Roemer.
d. Or approved equal.

2. Standard: UL 199.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGF Manufacturing Inc.
b. Triple R Specialty.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.
e. Viking Corporation.
f. Or approved equal.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following::

a. CECA, LLC.
b. Corcoran Piping System Co.
c. Merit Manufacturing; a division of Anvil International, Inc.
d. Or approved equal.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

E. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Fivalco Inc.
    b. FlexHead Industries, Inc.
    c. Gateway Tubing, Inc.
    d. Or approved equal.

2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.9 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Victaulic Company.
6. Viking Corporation.
7. Or approved equal.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

D. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, one piece, flat.

F. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
   e. Or approved equal.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Fill sprinkler system piping with water.

N. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.10 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:

1. Standard-weight, black-steel pipe with cut-or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright sprinklers.
5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 220000 – PLUMBING SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

1.2 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a (1) one year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect.

1.3 DEFINITIONS

A. For a complete list of definitions for this contract refer to the Division 1 specifications.

B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.4 SCOPE OF WORK

A. The following description of work will use the following abbreviations:

1. General Contractor – GC
2. Electrical Contractor – EC
3. Mechanical Contractor (HVAC) – MC
4. Plumbing Contractor – PC

B. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the mechanical work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:

1. For detailed scope of work for each plumbing system, refer to the respective Division 22 specification section.
2. Demolition and removal of fixtures and equipment as outlined in contract drawings.
3. Demolition and removal of all domestic hot and cold water and sanitary and vent piping as indicated on contract drawings.

4. Provide all plumbing fixtures, clean outs, access panels, sanitary waste and vent piping, domestic hot, cold and recirculation piping, hangers, supports, and controls as needed. Reconnect domestic hot and cold piping and sanitary and vent piping to existing piping where indicated.
5. Coordinate with GC, MC, and EC for the installation of all domestic water, sanitary and vent piping to ensure proper elevations, clearances, installation schedules, excavations & backfill, is performed in an orderly fashion.
6. Provide insulation of all plumbing equipment and piping.
7. Connect new sanitary line to new vents up through roof as shown on drawings.
8. Providing all necessary permits, approvals, fees, etc.
9. Provide instructions to the owner as outlined in these Specifications.
10. Provide all cutting and patching as required to perform the work of this contract.
11. Provide all necessary rigging as required to perform the work of this contract.
12. Provide manufacturer startup for all systems specified as outlined in these Specifications.
13. Provide removal of trash and general clean-up.
14. Provide as-built drawings.
15. Provide operation and maintenance manuals.
16. Completion Date: All plumbing work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.

C. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.

D. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the electrical work as indicated, required or implied by the drawings and as specified herein.

E. All of the specifications listed and all of the drawings listed are part of the Contract Documents of the Contractor. The Contractor shall review all drawings and specification divisions to determine the full scope of his work.

F. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Structural, Mechanical, Electrical, Plumbing, and Fire Protection) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

G. Coordination between the Plumbing Contractor and Electrical Contractor:

1. The Electrical Contractor shall:

    a. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
    b. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the Plumbing system and as required by the National Electrical Code, or as shown on the drawings, or as specified.

2. The Plumbing Contractor will:

    a. Furnish and set all motors for equipment provided as part of the Plumbing contract.

b. Furnish all motor starters, contactors, pushbuttons and switches for local and remote control of Plumbing equipment that is not provided by the Electrical Contractor and turn over to the Electrical Contractor for installation. Combination starters shall be furnished for individual (not attached to the equipment) and for packaged equipment regardless if specified or not in the respective sections of the specification.
c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strips.
d. Provide all-control wiring for all equipment, including all 120 V. controls. Only power supply connection to the equipment will be by the Electrical Contractor.

1.5 WARRANTY

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion."

B. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this School shall include a warranty on parts and labor. The duration of this warranty shall be as noted in paragraph 1.2.A above. This warranty shall supersede all notations in all the other Division 22 specification sections where warranties are shorter than the duration as noted in paragraph 1.2.A above.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION 220000

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Grout.
4. Plumbing demolition.
5. Equipment installation requirements common to equipment sections.
6. Painting and finishing.
7. Concrete bases.
8. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PVC: Polyvinyl chloride plastic.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.

e. Smith-Blair, Inc.
f. Viking Johnson.
g. Or approved equal.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

2.5 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

A. unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Firestops and Smokeseals" for materials.

M. Verify final equipment locations for roughing-in.

N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 220500

SECTION 220517 – SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal fittings.
4. Grout.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
3. Or approved equal.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.
6. Or approved equal.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Firestops and Smokeseals."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Firestops and Smokeseals."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

   a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves.

4. Interior Partitions:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Iron, grooved-end butterfly valves.
4. Bronze swing check valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. RS: Rising stem.

F. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball and plug valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
f. Or approved equal.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.

c. Legend Valve.
d. Milwaukee Valve Company.
e. Mueller Steam Specialty; a division of SPX Corporation.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. Or approved equal.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Cooper Cameron Valves; A div. of Cooper Cameron Corp.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Legend Valve.
f. Milwaukee Valve Company.
g. Mueller Steam Specialty; a division of SPX Corporation.
h. NIBCO INC.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. Or approved equal.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.4 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Or approved equal.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Ball or butterfly valves.
4. Pump-Discharge Check Valves:

   a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
   b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with stainless-steel ball and trim.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, stainless-steel disc.
4. Iron Swing Check Valves: Class 250, metal seats.

END OF SECTION 220523

SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.

2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.".

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
3. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.
3. Grinnell Corp.
4. GS Metals Corp.
5. National Pipe Hanger Corporation.
6. PHD Manufacturing, Inc.
7. PHS Industries, Inc.
8. Or approved equal.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.
7. Or approved equal.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

f. Or approved equal.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.
g. Or approved equal.

2.6 RESTRAINTS – STANCHION PIPE STAND TYPE

A. Description: Bracing assembly consisting of post secured to building structure, with adjustable height slotted steel channel assembly and pipe guide and strap. All metal parts shall be hot dip galvanized or stainless steel.

B. Manufacturers:

1. Miro Industries.
2. Approved Equal.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
10. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
14. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

K. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Water Piping:

    a. Background Color: Green.
    b. Letter Color: White.

2. Sanitary Waste and Storm Drainage Piping:

    a. Background Color: Black.
    b. Letter Color: White.

3. Natural Gas Piping:

    a. Background Color: Yellow.
    b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

    a. Cold Water: 1-1/2 inches round.
    b. Hot Water: 1-1/2 inches round.

2. Valve-Tag Color:

    a. Cold Water: Natural.
    b. Hot Water: Natural.

3. Letter Color:

    a. Cold Water: White.
    b. Hot Water: White.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic hot-water recirculation piping.
4. Sanitary waste piping.
5. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000-Degree Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.
    f. Or approved equal.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    d. Mon-Eco Industries, Inc.; 22-25.
    e. Or approved equal.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
    d. Mon-Eco Industries, Inc.; 22-25.
    e. Or approved equal.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.3 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   e. Or approved equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.
   d. Or approved equal.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

e. Or approved equal.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.4 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
   c. Or approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. C & F Wire.
   b. Or approved equal.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. McGuire Manufacturing.
   b. Plumberex.
   c. Truebro; a brand of IPS Corporation.
   d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
   e. Or approved equal.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

6. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 3/4 and Smaller: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1 and Larger: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot Water and Hot Water Recirculation:

1. NPS 3/4 and Smaller: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1 and Larger: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

a. Field Applied Jacket: PVC P-Trap and supply covers.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Storm Water Piping & Roof Drains:

1. Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

b. Provide insulation on the first 25 feet of horizontal storm piping. Bodies of roof drains to be insulated.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Specialty valves.
2. Flexible connectors.

1.3 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Domestic water piping.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than three days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner's written permission.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Copper Pressure-Seal-Joint Fittings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Elkhart Products Corporation; Industrial Division.
2) NIBCO INC.
3) Viega; Plumbing and Heating Systems.
4) Or approved equal.

b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    d. Zurn Plumbing Products Group; Wilkins Water Control Products.
    e. Or approved equal.

2. Description:

    a. Pressure Rating: 150 psig .
    b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Calpico, Inc.
    b. Lochinvar Corporation.
    c. Or approved equal.

2. Description:

    a. Galvanized-steel coupling.
    b. Pressure Rating: 300 psig at 225 deg F.
    c. End Connections: Female threaded.
    d. Lining: Inert and noncorrosive, thermoplastic.

D. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Perfection Corporation; a subsidiary of American Meter Company.
    b. Precision Plumbing Products, Inc.

c. Victaulic Company.
d. Or approved equal.

2. Description:

a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Metraflex, Inc.
6. Unaflex, Inc.
7. Or approved equal.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install shutoff valve immediately upstream of each dielectric fitting.

C. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

G. Install piping adjacent to equipment and specialties to allow service and maintenance.

H. Install piping to permit valve servicing.

I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

M. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

3.6 FLEXIBLE CONNECTOR INSTALLATION

A. Install bronze-hose flexible connectors in copper domestic water tubing.

B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.13 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) cast- or wrought-copper solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.

3.14 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated water mixing valves.
5. Hose bibbs.
6. Wall hydrants.
7. Drain valves.
8. Water hammer arresters.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.
e. Or approved equal.

B. Hose-Connection Vacuum Breakers

1. Manufactures: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. MIFAB, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Woodford Manufacturing Company.
e. Zurn Plumbing Products Group; Wilkins Div.
f. Or approved equal.

C. Pressure Vacuum Breakers

1. Manufactures: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Watts Industries, Inc.; Water Products Div.
e. Zurn Plumbing Products Group; Wilkins Div.
f. Or approved equal.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers to be installed at incoming domestic water service and at any branch lines to mechanical equipment.

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Size: Varies.
5. Design Flow Rate: Varies
6. Selected Unit Flow Range Limits: Varies.
7. Pressure Loss at Design Flow Rate: 15 psig for sizes NPS 2 and smaller; 15 psig for NPS 2-1/2 and larger.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufactures: Subject to compliance with requirements, provide products by one of the following:

    a. Cash Acme.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.
    f. Or approved equal.

2.3 BALANCING VALVE

A. Copper Alloy Calibrated Balancing Valve

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. ITT Industries; Bell & Gossett Div.
    c. NIBCO INC.
    d. TAC Americas.
    e. Taco, Inc.
    f. Watts Industries, Inc.; Water Products Div.
    g. Or approved equal.

B. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. Or approved equal.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Provide Powers model LFMM431 or an engineer approved equal from one of the following:

a. Armstrong International, Inc.
b. Leonard Valve Company.
c. Symmons Industries, Inc.
d. Watts Industries, Inc.; Water Products Div.
e. Zurn Plumbing Products Group; Wilkins Div.
f. Or approved equal.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F.
9. Tempered-Water Design Flow Rate: 15 gpm.
10. Valve Finish: Rough bronze.

2.5 WALL HYDRANTS

A. Non-freeze Wall Hydrants

1. Available Manufacturers: Provide model noted on plumbing schedules or an engineer approved equal by one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Prier Products, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Zurn Plumbing Products Group; Light Commercial Operation.
f. Or approved equal.

2.6 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Standard: ASSE 1003.

2. Pressure Rating: Initial working pressure of 150 psig.
3. Size: 1-1/2 NPS.
4. Design Flow Rate: 50 gpm .
5. Design Inlet Pressure: 100 psig.
6. Design Outlet Pressure Setting: 55 psig.
7. Body: Bronze for NPS 2 and smaller.
8. End Connections: Threaded for NPS 2 and smaller.

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

    a. StrainersNPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. MIFAB, Inc.
    c. PPP Inc.
    d. Sioux Chief Manufacturing Company, Inc.
    e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
h. Or approved equal.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install water hammer arresters in water piping according to PDI-WH 201.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Primary water tempering valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221123 – FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Grout.
7. Welding Criteria and Testing

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Pressure is 2 psig (regulated as required at equipment).

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.
6. Mechanical sleeve seals.
7. Welding certificates.

B. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

D. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

E. Qualification Data: For qualified professional engineer.

F. Welding certificates.

G. Field quality-control reports.

H. Operation and Maintenance Data: For motorized gas valves and pressure regulators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility for area where Project is located. Coordinate with utility to perform the work at the gas assembly to occur at the same time to minimize the down time for the Owner.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only

after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's written permission.
3. Interruption of natural-gas service shall only be for indicated length of time indicated by the Owner and these contract documents.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lee Brass Company.
    b. McDonald, A. Y. Mfg. Co.
    c. Or approved equal.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Sensus
   b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   c. Invensys.
   d. Maxitrol Company.
   e. Or approved equal.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 10 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Sensus.
   b. Maxitrol Company.
   c. SCP, Inc.
   d. Or approved equal.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code and PECO requirements for installation and purging of natural-gas piping.

B. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

C. Install fittings for changes in direction and branch connections.

3.4 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code and PECO requirements for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Prohibited Locations:

a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 22 Section "Hangers and Supports."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.8 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Division 22 Section "Mechanical Identification" for piping and valve identification.

3.10 PAINTING

A. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    c. Topcoat: Exterior alkyd enamel (semigloss).
    d. Color: Gray.

B. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI INT 5.1E.

    a. Prime Coat: Quick-drying alkyd metal primer.
    b. Intermediate Coat: Interior alkyd matching topcoat.
    c. Topcoat: Interior alkyd (semigloss).
    d. Color: Gray.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 PIPING SCHEDULE

A. Aboveground, branch piping NPS 2 and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping NPS 2-1/2 and larger shall be one of the following:

1. Steel pipe with wrought-steel fittings and welded joints.

3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. Bronze plug valve.

B. Valves in branch piping for single appliance shall be the following:

1. Bronze plug valve.

END OF SECTION 221123

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

D. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

1) ANACO.
2) Fernco, Inc.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.

5) Tyler Pipe; Soil Pipe Div.
6) Or approved equal.

2.5 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent, Schedule 40.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel couplings; and hubless-coupling joints.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

D. Underground, soil, waste, and vent piping NPS 6 and smaller shall be any of the following:

1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe Material Couplings: Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small differences in OD.

3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4: 60 inches with 5/8-inch rod.

E. Install supports for vertical cast-iron soil piping every 15 feet.

F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sewage Pumps: To sewage pump discharge.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Through-penetration firestop assemblies.
5. Miscellaneous sanitary drainage piping specialties.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. PP: Polypropylene plastic.

C. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. Sioux Chief Manufacturing Company, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Light Commercial Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.

5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith as scheduled or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Light Commercial Operation.
    f. Or approved equal.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast Iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Dimensions of Top or Strainer: 5 inch diameter.
16. Top Loading Classification: Light Duty.
17. Funnel: Not required.
18. Inlet Fitting: Not required.
19. Trap Material: Cast iron.
20. Trap Pattern: Deep Seal P-trap.
21. Trap Features: Pro-Set Trap Guard.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Acorn Engineering Company; Elmdor/Stoneman Div.
    b. Thaler Metal Industries Ltd.
    c. Or approved equal.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-, 0.0938-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ProSet Systems Inc.

b. Or approved equal.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

I. Assemble open drain fittings and install with top of hub 1 inch above floor.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install vent caps on each vent pipe passing through roof.

M. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

N. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Hubless, cast-iron soil pipe and fittings.
   2. PVC pipe and fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   1. Structural members to which drainage piping will be attached or suspended from.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 FIELD CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

   1. Notify Architect no fewer than two days in advance of proposed interruption of storm drainage service.
   2. Do not proceed with interruption of storm drainage service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Standard: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:
1. Couplings shall bear CISPI collective trademark and NSF certification mark.
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

A. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665; drain, waste, and vent.

C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.

1. Do not change direction of flow more than 90 degrees.
2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

a. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping.
2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install underground PVC piping according to ASTM D 2321.

O. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.

    a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
    b. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."

2. Install drains in storm drainage gravity-flow piping.

    a. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hubless, Cast-Iron Soil Piping Coupled Joints:

1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendices.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendices.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting[, valve,] and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.

2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, at final connection to each piece of equipment.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Test Procedure:

    a. Test storm drainage piping on completion of roughing-in.
    b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

C. Piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

C. Underground storm drainage piping shall be the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal roof drains.
2. Cleanouts.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.
2. Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Small-Sump, General-Purpose Roof Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

    a. Smith, Jay R. Mfg. Co; Division of Smith Industries, Inc.
    b. Watts Drainage Products Inc.
    c. Zurn Plumbing Products Group
    d. Or approved equal.

2. Standard: ASME A112.6.4.

3. Body Material: Cast iron.
4. Dimension of Body: Nominal 8-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom.
7. Outlet Type: No hub.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Expansion Joint: Required.
11. Sump Receiver Plate: Required.
12. Dome Material: Cast iron.
13. Wire Mesh: Stainless steel or brass over dome.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. Sioux Chief Manufacturing Company, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Light Commercial Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.

3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Test Tees:
1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk or raised head, brass.
5. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical storm piping conductor.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install test tees in vertical conductors and near floor.

F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

G. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 223400 - FUEL FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following fuel-fired water heaters:

1. Commercial, high-efficiency, gas water heaters.
2. Compression tanks.
3. Water heater accessories.

1.3 DEFINITIONS

A. LP Gas: Liquefied-petroleum fuel gas.

1.4 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Product Certificates: For each type of commercial water heater, signed by product manufacturer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASHRAE/IESNA 90.1-2004Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

E. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Commercial, Gas Water Heaters:

1) Storage Tank & Heating Elements: Fifteen years.
2) Controls and Other Components: Five years.

b. Compression Tanks: Two year(s).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. PVI
2. Or approved equal.

2.2 COMMERCIAL, GAS WATER HEATERS

A. Commercial, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3. Refer to plumbing Domestic Water Heater Schedule on drawing P4.1 for make and model of water heater.

1. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions. Following features and attributes may be modified or omitted if water heater otherwise complies with requirements for performance.
2. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.

    a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

        1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
        2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

    b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

3. Factory-Installed, Storage-Tank Appurtenances:

    a. Anode Rod: Replaceable magnesium.
    b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
    c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
    e. Jacket: Steel with enameled finish.
    f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

4. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural-gas fuel.

5. Temperature Control: Adjustable thermostat.
6. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
7. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.

2.3 COMPRESSION TANKS

A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Available Manufacturers:

   a. AMTROL Inc.
   b. Armstrong Pumps, Inc.
   c. Watts Regulator Co.
   d. Engineer approved equal

2. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.
   d. ASME Construction: Required.

3. Capacity and Characteristics:

   a. Working-Pressure Rating: 150 psig.
   b. Capacity Acceptable: See hot water heater details compression tanks.

2.4 WATER HEATER ACCESSORIES

A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.

B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.

C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.

D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

F. Water Heater Stand and Drain Pan Units: High-density-polyethylene-plastic, 18-inch-high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1 pipe thread.

G. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

H. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.

I. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004 or ASHRAE 90.2-2004.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install gas water heaters according to NFPA 54.

D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.

E. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

F. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

G. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

H. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

J. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

K. Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

N. Fill water heaters with water.

O. Charge compression tanks with air.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 223400

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets lavatories.
2. Laminar-flow faucet-spout outlets.
3. Toilet seats.
4. Fixture supports.
5. Water closets.
6. Lavatories.
7. Mop Receptors.

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

D. PVC: Polyvinyl chloride plastic.

E. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Plastic Mop-Service Basins: ANSI Z124.6.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
4. Vitreous-China Fixtures: ASME A112.19.2M.
5. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
3. Faucets: ASME A112.18.1.
4. Hose-Connection Vacuum Breakers: ASSE 1011.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
7. NSF Potable-Water Materials: NSF 61.
8. Pipe Threads: ASME B1.20.1.
9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
10. Supply Fittings: ASME A112.18.1.
11. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Grab Bars: ASTM F 446.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Toilet Seats: ANSI Z124.5.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures of unit shell.
   b. Faulty operation of controls, blowers, pumps, heaters, and timers.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 10 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Or approved equal.

B. Lavatory Supports:

1. Description: Type I, lavatory carrier with exposed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.2 WATER CLOSETS (P-1 & P-1A)

A. Water Closet:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:

a. Kohler Co.
b. TOTO USA, Inc.
c. Zurn, Inc.
d. American Standard Companies, Inc.
e. Or approved equal.

2. Description: See plans

2.3 URINALS (P-2 & P-2A)

A. Urinals:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:

a. Kohler Co.
b. TOTO USA, Inc.
c. Zurn, Inc.
d. American Standard Companies, Inc.
e. Or approved equal.

2. Description: See plans

2.4 LAVATORY (P-3 & P-4)

A. Lavatory:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:

a. American Standard Companies, Inc.
b. Briggs Plumbing Products, Inc.
c. Crane Plumbing, L.L.C./Fiat Products.
d. Kohler Co.
e. Or approved equal.

2. ADA Covers: Plumberex Pro-Extreme pipe covers, complete with p-trap cover and supply and valve covers.

B. Lavatory Station, (P-5):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Express Lavatory System SS Series SS-3N Wash Basin sensor operated or a comparable product by one of the following:

a. American Standard Companies, Inc.
b. Sloan.
c. Zurn Plumbing Products Group; Commercial Brass Operation.
d. Or Approved Equal.

2. Description: plug-in, electronic-sensor-operated.

a. Standard: ASME A112.18.1/CSA B125.1 and UL 1951.

b. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
c. Construction: Terreon
d. Maximum Flow Rate: 0.5 gpm
e. Inlet(s): NPS 1/2.
f. Spout: Rigid type integrated into Wash Bar.
g. Spout Outlet: Non-aerating spray.
h. Operation: 120VAC, 15A GFCI minimum duplex outlet.
i. Tempering Device: ASSE 1070 approved valve.

2.5 MOP RECEPTOR (P-7)

A. Mop Receptor:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:

a. Fiat.
b. Crane Plumbing, L.L.C./Fiat Products.
c. Florestone Products Co., Inc.
d. Precast Terrazzo Enterprises, Inc.
e. Stern-Williams Co., Inc.
f. Or approved equal.

2.6 SHOWER (P-6 & P-6A)

A. Mop Receptor:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:

a. Powers.
b. Crane Plumbing, L.L.C.
c. Kohler Co.
d. LASCO Bathware.
e. American Standard.
f. Speakman, Inc.
g. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.

E. Install fixtures level and plumb according to roughing-in drawings.

F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

I. Install toilet seats on water closets.

J. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

K. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

L. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

M. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

N. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

O. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

P. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224700 – ELECTRIC WATER COOLERS AND DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1. This Section includes the following water coolers and related components:

    1. Pressure water coolers.
    2. Fixture supports.

1.3 DEFINITIONS

1. Accessible Water Cooler: Fixture that can be approached and used by people with disabilities.

2. Fitting: Device that controls flow of water into or out of fixture.

3. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

1. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

2. Shop Drawings: Diagram power, signal, and control wiring.

3. Field quality-control test reports.

4. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act" ; and Public Law 101-336, "Americans with Disabilities Act" ; for fixtures for people with disabilities.

3. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

4. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

5. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

6. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 EXTRA MATERIALS

1. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

    1. Filter Cartridges: Equal to 50 percent of amount installed for each type and size indicated, but no fewer than 2 of each.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS (P-8)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elkay Manufacturing Co.
    b. Halsey Taylor.
    c. Oasis Corporation.
    d. Sunroc Corp.
    e. Or approved equal.

    2. Description: See plans

2.2 FIXTURE SUPPORTS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    1. Josam Co.
    2. MIFAB Manufacturing, Inc.
    3. Smith, Jay R. Mfg. Co.

4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Or approved equal.

3. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

    1. Type I: Hanger-type carrier with two vertical uprights.
    2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
    3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

1. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

2. Examine walls and floors for suitable conditions where fixtures are to be installed.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

1. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

2. Use mounting frames for recessed water coolers, unless otherwise indicated.

3. Set remote water coolers on floor, unless otherwise indicated.

4. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

1. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

2. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

3. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

4. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

5. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

6. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

7. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

1. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

2. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

4. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

1. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

    1. Remove and replace malfunctioning units and retest as specified above.
    2. Report test results in writing.

3.6 ADJUSTING

1. Adjust fixture flow regulators for proper flow and stream height.

2. Adjust water cooler temperature settings.

3.7 CLEANING

1. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

2. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

SECTION - 230000 MECHANICAL SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

B. The requirements of all other sections of Division 23 apply to this section.

1.2 DEFINITIONS

A. Provide: Means to furnish, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.3 SUMMARY

A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary to complete the installation of the work as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:

1. Remove heating and ventilating units in their entirety including, but not limited to, unit, supply, return and outside air ductwork, heating hot water piping to points noted on plans, wall mounted thermostat, supply and return grilles, controls, wiring, hangers and supports.
2. Remove unit ventilators in their entirety including, but not limited to, unit, heating hot water piping to points noted on plans, outside air ductwork, louver, wall mounted thermostat, supply and return grilles, controls, wiring, hangers and supports.
3. Remove rooftop units in their entirety including, but not limited to, unit, supply, return and outside air ductwork, wall mounted thermostat, supply and return grilles, controls, wiring, hangers and supports.
4. Provide new rooftop units including, but not limited to, supply and return ductwork, gas piping, grilles and diffusers, insulation, hangers, supports, controls and wiring as indicated on drawings.
5. Provide new self-contained unit ventilators including, but not limited to, condensate drains, hot water supply and return piping, supply ductwork, grilles, ducts from back of the unit to the louver, blank off panels, insulation, hangers, controls and wiring.
6. Provide new indoor air handling units and associated condensing units including, but not limited to, supply return, exhaust, outside air ductwork, hot water supply and return piping, refrigerant piping, grilles and diffusers, insulation hangers, supports, controls and wiring as indicated on drawings.

7. Provide new natural gas piping to all new rooftop equipment as indicated on plans.
8. Provide and install insulation for ductwork including requirements for internal lining for ductwork as indicated within the specifications.
9. Provide all pipe materials and ductwork materials and construction as outlined on drawings and within specifications.
10. Provide testing, adjusting and balancing for all new HVAC Systems.
11. Provide new unitary controls for new HVAC equipment as outlined on drawings and within specifications and seamlessly integrate into existing Automated Logic controls system.
12. By law, the heating system must be operational by October 15th. If the heating system cannot be operational by October 15th, the contractor is responsible for providing temporary heating for the school.
13. During the summer construction period, there will be a two-week power outage to the building while the electrical service is replaced under a separate project. The mechanical contractor shall include in their base bid price the cost to provide temporary generator power and lighting for their construction activities during this two-week power outage. There will be separate two-week outages at each school during the summer. The final timing of this outage will be determined by the electrical contractor replacing the electrical service.
14. Care should be taken to avoid disturbing existing equipment, piping and ductwork, etc. which are to remain.
15. Provide all work noted in all of the specifications and drawings.
16. Provide all cutting and patching as required to perform the work of this contract.
17. Provide all necessary permits and approvals.
18. Provide all necessary rigging as required to perform the work of this contract.
19. Provide operation and maintenance manuals and record as-built drawings for everything installed in this contract.
20. Provide instructions and factory authorized training to owner of all equipment provided in this contract.
21. Provide cleanup and removal of all construction debris and other trash on a daily basis.

B. Note that this Summary of Work specification is intended to help delineate work. It does not mean that this is necessarily all of the work. It is ultimately the responsibility of the Contractor and their subcontractors to look at all the Contract Documents and all field conditions to determine the full extent of work for this project.

C. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.

D. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the work as indicated, required or implied by the drawings and as specified herein.

E. All of the specifications listed and all of the drawings listed are part of the Contract Documents of the Contractor. The Contractor shall review all drawings, other documents and specification divisions to determine the full scope of his work.

F. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Stuctural, Mechanical and Electrical) and contract documents to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work has been included in the Proposal. It will also be considered an indication that a

thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

G. Coordination between the Mechanical Contractor and Electrical Contractor:

1. The Electrical Contractor shall:

a. Receive and set the motor starters, etc. as provided by the Mechanical Contractor.
b. Provide power wiring, including final connection of same, from source to starters or contactors to motors.
c. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
d. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the HVAC system and as required by the National Electrical Code, or as shown on the drawings, or as specified.
e. Adjust connections to electrical motors to ensure proper rotation.
f. Provide fire alarm duct detectors and remote test stations and wire/program in the fire alarm system. Turn over the duct detector in a housing and the correctly sized air tubes to the mechanical contractor for installation on the ductwork.

2. The Mechanical Contractor will:

a. Furnish and set all motors for equipment provided as part of the HVAC contract.
b. Furnish all motor starters, variable frequency drives, contactors, pushbuttons and switches for local and remote control of HVAC equipment that is not provided by the Electrical Contractor and turn over to the Electrical Contractor for installation. Combination starters shall be furnished for individual (not attached to the equipment) and for packaged equipment regardless if specified or not in the respective sections of the specification.
c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strip.
d. Furnish and install duct and pipe-mounted control devices, such as freezestats, aquastats, flow switches, etc.
e. Furnish wiring diagrams for the systems power wiring, in sufficient time to allow roughing-in of conduit in accordance with the proposed work schedule.
f. Receive the fire alarm duct detector housing and air sampling tubes from the EC and install in the ductwork. MC is required to wire from the relay base of the duct detector into the HVAC unit starter/VFD for shut-down upon detection of smoke.
g. Provide all control wiring including 120V controls, 120V power and 120/24V control power transformers as required for a complete and fully functional HVAC DDC control system.

1.5 WARRANTY

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of “Substantial Completion.”

B. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the

Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this Owner shall include a two-year warranty on parts and labor. This warranty shall supersede all notations in all the other Division 23 specification sections that are shorter than two years.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable).

END OF SECTION 230000

SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. HVAC demolition.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Mechanical sleeve seals.
3. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Or approved equal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Electronically commutated
3. Split phase.
4. Capacitor start, inductor run.
5. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, electronically commutated.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test plug kits.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. H.O. Trerice Company.
b. Weiss Instruments.
c. Moeller Instruments.
d. Or approved equal.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.

a. Design for Air-Duct Installation: With ventilated shroud.
b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. H.O. Trerice Company.
b. Weiss Instruments.
c. Moeller Instruments.

d. Or approved equal.

2. Standard: ASME B40.100.
3. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 pipe threads.

C. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. H.O. Trerice Company.
b. Weiss Instruments.
c. Moeller Instruments.
d. Or approved equal.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. H.O. Trerice Company.
b. Weiss Instruments.
c. Moeller Instruments.
d. Or approved equal.

B. Furnish one test-plug kit(s) containing one thermometer, one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. High-Range Thermometer: Small, bimetallic insertion type with 1 to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2 to 3-inch diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.

I. Install connection fittings in accessible locations for attachment to portable indicators.

J. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each boiler and secondary pump shall be the following:

1. Industrial-style, liquid-in-glass type.

B. Thermometers at inlet and outlet of each hydronic zone shall be the following:

1. Industrial-style, liquid-in-glass type.

C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at suction and discharge of each pump shall be one of the following:

1. Sealed, direct-mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each boiler shall be one of the following:

1. Sealed, direct-mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron high performance butterfly valves.
3. Bronze swing check valves.
4. Iron swing-check valves.

B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non-rising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Or approved equal.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.3 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Single-Flange, High-Performance Butterfly Valves, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.

c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.

h. Or approved equal.

2. Description:

a. Standard: MSS SP-68.
b. CWP Rating: 285 psig at 100 deg F.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: Stainless steel.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from seat plane.
g. Disc: Stainless steel.
h. Service: Bidirectional.

2.4 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Or approved equal.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.5 IRON SWING CHECK VALVES

A. Carbon Steel Swing Check Valves with Metal Seats, Class 250:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mueller Co.
b. Nibco, Inc.
c. Apollo.

d. Or approved equal.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions, Victaulic coupling or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for butterfly NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.
2. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2-1/2 and Larger: Flanged ends.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two-piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron High Performance Butterfly Valves, NPS 2-1/2 to NPS 12: 300 CWP.
2. Iron Check Valves, NPS 2-1/2 to NPS 12: 500 CWP.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube and Conduit.
b. B-line.
c. Unistrut.

d. Or approved equal.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc.

2.4 THERMAL-HANGER SHIELD INSERTS FOR FIBERGLASS INSULATED PIPING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. National Pipe Hanger Corporation.
2. Pipe Shields, Inc.
3. Piping Technology and Products, Inc.
4. Armaflex
5. Or approved equal.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 INSULATION PIPE HANGER FOR PIPING WITH FLEXIBLE ELASTOMERIC INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armaflex Armafix IPH

B. Single-piece thermally insulated pipe hanger with self-adhesive closure. CFC-free PUR/PIR load-bearing segments embedded in closed cell insulation with outer shell of 30-mil thick painted aluminum.

C. Shall be installed under all insulated lines at unistrut clamps, clevis hangers, or locations where insulation may be compressed.

D. The seams shall be sealed with Armaflex 520, 520 Black or 520 BLV contact adhesive. To minimize the movement of Armafix, it is recommended that a pair of non-skid pads be adhered to the clamps. In addition, to prevent loosening of the clamps, use of an anti-vibratory fastener, such as a nylon-locking nut, is also recommended.

2.6 VRF PIPING HANGER SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hydra-Zorb, TRH Hanger system.

B. Corrosion resistant, black zinc-coated spring steel hanger can be attached to 1/4” to 3/8” threaded rod or used to secure refrigerant lines to flat surfaces.

2.7 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert for piping with fiberglass insulation and Armafix IPH for piping with flexible elastomeric insulation.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
6. Install Armafix IPH at all hangers where flexible elastomeric is utilized for piping.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099110 "Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
15. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
16. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
18. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

19. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
20. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.

c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548 – VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Freestanding spring isolators.
4. Spring hangers.
5. Spring hangers with vertical-limit stops.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Welding certificates.

C. Qualification Data: For professional engineer and testing agency.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Mountings & Controls, Inc.
8. Or approved equal.

B. Pads: ranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

F. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with installation tolerance requirements and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION-CONTROL DEVICE INSTALLATION

A. Install cables so they do not bend across edges of adjacent equipment or building structure.

B. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

C. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until full design strength is achieved.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator deflection.
7. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

END OF SECTION 230548

SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Hot Water Piping:

a. Background Color: Green.
b. Letter Color: White.

2. Gas Piping:

a. Background Color: Yellow.
b. Letter Color: Black.

3. Domestic Cold Water Make-Up Piping:

a. Background Color: Green.
b. Letter Color: White

4. Condensate-Water Piping:

a. Background Color: Green.
b. Letter Color: White.

5. Refrigerant Piping:

a. Background Color: Black.
b. Letter Color: White

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Hot Water: 1-1/2 inches, round.
b. Gas: 1-1/2 inches, round.

2. Valve-Tag Color:

    a. Hot Water: Natural.
    b. Gas: Natural.

3. Letter Color:

    a. Hot Water: Black.
    b. Gas: Black.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

    a. Constant-volume air systems.

2. Balancing Hydronic Piping Systems:

    a. Constant-flow hydronic systems.

3. Testing, Adjusting, and Balancing Equipment:

    a. Motors.
    b. Condensing units.
    c. Heat-transfer coils.

4. Procedures for Testing, Adjusting, and Balancing Existing Systems.
5. Controls Verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

    a. The Contract Documents examination report.
    b. The TAB plan.
    c. Needs for coordination and cooperation of trades and subcontractors.
    d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Certified TAB reports.

F. Sample report forms.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in

AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230700 "HVAC Insulation"

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.
3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    a. Report the cleanliness status of filters and the time static pressures are measured.
4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

   a. Position valves for full flow through coils.
   b. Measure flow by main flow meter, if installed.
   c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

   a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
   b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
   c. Convert pressure to head and correct for differences in gage heights.
   d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
   e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.

5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.7 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.8 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.9 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

B. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.

5. Refrigerant suction pressure and temperature.

3.11 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.12 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.13 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.14 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.15 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.

f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Unit Ventilator Test Reports: For unit ventilators with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Heating-coil static-pressure differential in inches wg.
g. Outdoor airflow in cfm.
h. Return airflow in cfm.
i. Outdoor-air damper position.
j. Return-air damper position.
k. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch o.c.
    f. Make and model number.
    g. Face area in sq. ft..
    h. Tube size in NPS.
    i. Tube and fin materials.
    j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Average face velocity in fpm.
    c. Air pressure drop in inches wg.
    d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
    e. Return-air, wet- and dry-bulb temperatures in deg F.
    f. Entering-air, wet- and dry-bulb temperatures in deg F.
    g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    h. Water flow rate in gpm.
    i. Water pressure differential in feet of head or psig.
    j. Entering-water temperature in deg F.
    k. Leaving-water temperature in deg F.
    l. Refrigerant expansion valve and refrigerant types.
    m. Refrigerant suction pressure in psig.
    n. Refrigerant suction temperature in deg F.

G. System-Coil Reports: For finned tube radiation and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling-unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Entering-water temperature in deg F.
    c. Leaving-water temperature in deg F.
    d. Water flow rate in gpm.
    e. Water pressure drop in feet of head or psig.
    f. Entering-air temperature in deg F.
    g. Leaving-air temperature in deg F.

H. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

    a. Total air flow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

I. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch o.c.
    f. Make and model number.
    g. Face area in sq. ft.

h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Entering-water temperature in deg F.
i. Leaving-water temperature in deg F.
j. Refrigerant expansion valve and refrigerant types.
k. Refrigerant suction pressure in psig.
l. Refrigerant suction temperature in deg F.

J. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.

l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

K. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

L. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

M. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

N. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.16 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Engineer.

B. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.17 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 – HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

    a. Mineral fiber.

2. Adhesives.
3. Mastics.
4. Lagging adhesives.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.
9. Securements.

B. Related Sections:

1. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
d. Or approved equal.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; All-Service Duct Wrap.
f. Or approved equal.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with

factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.
    c. Johns Manville; 800 Series Spin-Glas.
    d. Knauf Insulation; Insulation Board.
    e. Manson Insulation Inc.; AK Board.
    f. Owens Corning; Fiberglas 700 Series.
    g. Or approved equal.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000 Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.
    f. Or approved equal.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.
    f. Or approved equal.

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.

c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
f. Or approved equal.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.
g. Or approved equal.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.
f. Or approved equal.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.

c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc.; 55-70.
e. Or approved equal.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.
g. Or approved equal.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.
f. Or approved equal.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.
f. Or approved equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKET

A. Self-Gripping Outdoor Jacket: Airex Manufacturing, Inc. E-Flex Guard, flexible UV and weather resistant insulation protector. The PVC plastic pipe insulation cover shall feature an integrated, outdoor rated durability, industrial grade full enclosure fastening system with Velcro fasteners. Wrapping tape or adhesive tape shall not be permitted.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.

b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
e. Or approved equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
e. Or approved equal.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.
d. Or approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015-inch thick, 3/4-inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, 3/4-inch wide with wing seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.
5) Or approved equal.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.
5) Or approved equal.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.
4) Or approved equal.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) GEMCO; Nylon Hangers.
2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
3) Or approved equal.

b. Baseplate: Perforated, nylon sheet, 0.030-inch thick by 1-1/2 inches in diameter.

c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
3) Midwest Fasteners, Inc.; Self Stick.
4) Or approved equal.

b. Baseplate: Galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.
5) Or approved equal.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) GEMCO.
2) Midwest Fasteners, Inc.
3) Or approved equal.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. C & F Wire.
    b. Childers Products.
    c. PABCO Metals Corporation.
    d. RPR Products, Inc.
    e. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface.

Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and threelocations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.

4. Indoor, exposed return located in nonconditioned space.

5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Round and flat-oval, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

B. Rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

C. Rectangular, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 4 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.

2. NPS 3 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1-inch thick.

B. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: [3/4 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Refrigerant Piping (ALL):

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Refrigerant Piping, Exposed:

1. Airex Manufacturing, Inc. E-Flex Guard insulation protective cover.

a. Color: White.

END OF SECTION 230700

SECTION 230900 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 233300 - Duct accessories:
   1. Airflow stations
   2. Automated dampers
   3. Terminal unit controls

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Controls by others as indicated elsewhere in this specification section, on the drawings or in the Sequence of Specifications.

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

A. Section Not Used

1.4 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
B. The following sections but not limited to constitute related work:
   1. Section 237413 – Packaged, Outdoor, Central-Station Air-Handling Units
   2. Section 230593 - Testing, Adjusting, and Balancing
   3. Section 260519 – Low-Voltage Electrical Power Conductors and Cables
   4. Section 260523 – Control-Voltage Electrical Power cable

1.5 DESCRIPTION

A. The control system described herein shall be an extension of the Union College Honeywell Tridium Jace by AME. All new point data shall be accessed through Union College's existing Honeywell controls and software. All new systems and graphics furnished as part of this project shall appear and function in a similar fashion to the existing system and shall be accessed through a new graphic icon on the existing opening graphic page and a new link on the navigation tree.
B. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface. The Owner shall provide an IP address to allow this system to be accessed, configured, and programmed via the internet.
C. The system shall directly control HVAC equipment as specified per the Sequence of Operation listed on the Mechanical Drawings. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start

and stop, night setback, request-based logic, and demand level adjustment of set points as specified in the control sequence of operations.

D. System shall use the BacNet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, set points, trends, and alarms specified in the "Sequence of Operations for HVAC Controls" shall be BacNet objects. All controllers shall currently be BTL (BacNet Testing Laboratories) listed. Controllers utilizing MS/TP communications (slave “unitary” controllers residing on a sublan with “master” controllers) will not be allowed.
E. Provide Energy and Environmental Reports as described in the “System Software” section below.
F. Provide an Environmental Index graphic as described in the “System Software” section below.
G. BAS Contractors Responsibilities Include:
    1. The Contractor shall furnish and install all necessary software and hardware, wiring, and computing equipment in compliance with this specification. Any variances from this specification or related documentation shall be submitted in writing at the time of bid.
    2. The control sequences describe all necessary equipment operation including those operations that are provided by the HVAC equipment manufacturers and those as part of the central control system. Refer to individual equipment specifications for devices provided by the HVAC equipment manufacturers. It is the responsibility of the mechanical contractor to provide a fully coordinated and operational control system.
    3. Provide the following electrical work as work of this section, complying with requirements of applicable Division 16 sections:
        a. Control wiring between field-installed controls, indicating devices, and unit control panels consistent with ANSI/TIA/EIA-862.
        b. All monitoring and control wiring required for controls and instrumentation consisting with ANSI./TIA/EIA-862.
    4. This contractor shall provide all control dampers except for those provided as part of packaged HVAC equipment.

1.6 APPROVED CONTROL SYSTEMS

A. The Basis of Design is AME Inc.

B. Or approved equal.

1.7 QUALITY ASSURANCE

A. Installer and Manufacturer Qualifications
    1. Installer shall be a factory-owned branch office of the Control System Manufacturer.
    2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.
    3. The DDC Contractor must have the following ratings, certifications, and registrations:
        a. New Jersey Public Works Contractor Registration Act
        b. New Jersey Department of Treasury, Division of Property Management and Construction. Minimum $15,000,000 classification for control systems and energy management systems.
        c. New Jersey Schools Construction Corporation Qualification rating of $15,000,000.00
        d. The DDC contractor shall have a designated engineering department with at least ten full-time engineers.
        e. The DDC contractor shall have an established service organization. A maximum eight-hour service technician response time shall be guaranteed by the DDC contractor.

f. The DDC contractor shall have an independently verifiable inventory of electronic service parts.
g. The DDC contractor shall have completed a minimum of twenty projects within the last five years which are at least equal in dollar and scope to this project. A list of similar projects, dollar volume, scope, contact name and contact number shall be provided by the DDC contractor if requested by the Owner.

1.8 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
   1. National Electric Code (NEC)
   2. International Building Code (IBC)
      a. Section 719 Ducts and Air Transfer Openings
      b. Section 907 Fire Alarm and Detection Systems
      c. Section 909 Smoke Control Systems
      d. Chapter 28 Mechanical
   3. International Mechanical Code (IMC)
   4. ANSI/ASHRAE 135-2004: Data Communication Protocol for Building Automation and Control Systems (BACNET)
   5. Title 52 of N.J.S.A. requires that only domestic materials are to be used on public works contracts. N.J.S.A. 18A:18A-20 which applies to all public Schools in the State of New Jersey also requires that American goods and products must be used.

1.9 SYSTEM PERFORMANCE

A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
   1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
   2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
   3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
   4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
   5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 sec.
   6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
   7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
   8. Multiple Alarm Annunciations. Each workstation on the network shall receive alarms within 5 sec of other workstations.
   9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.

10. Control Stability and Accuracy. Control loops shall maintain measured variable at set point within tolerances listed in Table 2.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC (±1ºF)
Ducted Air	±0.5ºC (±1ºF)
Outside Air	±1.0ºC (±2ºF)
Dew Point	±1.5ºC (±3ºF)
Water Temperature	±0.5ºC (±1ºF)
Delta-T	±0.15ºC (±0.25ºF)
Relative Humidity	±5% RH
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO_2)	±50 ppm

Note 1: Accuracy applies to 10% - 100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0ºC (±2.0ºF)	
Duct Temperature	±1.5ºC (±3ºF)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

1.10 SUBMITTALS

A. Product Submittal Requirements: Meet requirements of Section 013300 Submittal Procedure. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2010 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 3 prints of each drawing on 11" x 17" paper. When manufacturer's cut sheets apply to a product series rather than a specific

product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals within 12 weeks of contract award on the following:

1. Direct Digital Control System Hardware
    a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
    b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
        i. Direct digital controllers (controller panels)
        ii. Transducers and transmitters
        iii. Sensors (include accuracy data)
        iv. Actuators
        v. Valves
        vi. Relays and switches
        vii. Control panels
        viii. Power supplies
        ix. Batteries
        x. Operator interface equipment
        xi. Wiring
    c. Wiring diagrams and layouts for each control panel. Show termination numbers.
    d. Floor plan schematic diagrams indicating field sensor and controller locations.
    e. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Central System Hardware and Software
    a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
    b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
        i. Central Processing Unit (CPU) or web server
        ii. Monitors
        iii. Keyboards
        iv. Power supplies
        v. Battery backups
        vi. Interface equipment between CPU or server and control panels
        vii. Operating System software
        viii. Operator interface software
        ix. Color graphic software
        x. Third-party software
    c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.
    d. Network riser diagrams of wiring between central control unit and control panels.
3. Controlled Systems
    a. Riser diagrams showing control network layout, communication protocol, and wire types.
    b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.

c. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
d. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
e. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified in 230900 Appendix A (Sequences of Operation). Indicate alarmed and trended points.

4. Description of process, report formats, and checklists to be used in Section 230900 Article 3.18 (Control System Demonstration and Acceptance).
5. BacNet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

B. Schedules
1. Schedule of work provided within one month of contract award, indicating:
a. Intended sequence of work items
b. Start date of each work item
c. Duration of each work item
d. Planned delivery dates for ordered material and equipment and expected lead times
e. Milestones indicating possible restraints on work by other trades or situations
2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C. Project Record Documents. Submit three copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:
1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 6 prints of each drawing on 11" x 17" paper.
2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 230900 Article 3.18 (Control System Demonstration and Acceptance).
3. Certification of pressure test required in Section 230900 Article 3.10 (Control Air Tubing).
4. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:
a. As-built versions of submittal product data.
b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
d. Programming manual or set of manuals with description of programming Language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.

f. Documentation of programs created using custom programming Language including set points, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, set points, tuning parameters, and objects can be viewed using furnished programming tools.
g. Graphic files, programs, and database on magnetic or optical media.
h. List of recommended spare parts with part numbers and suppliers.
i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
j. Complete original-issue copies of furnished software, including operating systems, custom programming Language, operator workstation or web server software, and graphics software.
k. Licenses, guarantees, and warranty documents for equipment and systems.
l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

D. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.

1.11 WARRANTY

A. Warrant work as follows:
1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

1. Graphics
2. Record drawings
3. Database
4. Application programming code
5. Documentation

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BacNet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2004, BacNet.
B. Install new wiring and network devices as required to provide a complete and workable control network. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
    1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
    2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in 230900 Appendix A (Sequences of Operation). An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
E. Controllers with real-time clocks shall use the BacNet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.
F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
G. System shall support Web services data exchange with any other system that complies with XML (extensible markup Language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.

1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
3. For read or write requests, the system shall require user name and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.
4. System shall support discovery through a Web services connection or shall provide a tool available through the Operator Interface that will reveal the path/identifier needed to allow a third party Web services device to read data from or write data to any object in the system which supports this service.

2.3 OPERATOR INTERFACE WITH EXISTING WEBCONTROL SOFTWARE

A. General: All controllers shall become part of Union College's existing Building Automation System. Server hardware and system software are described in Section 2.3 are existing. Where configuration of software is described, it shall be performed as needed to integrate the new hardware into the existing system.

B. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:
   1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.
   2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.
   3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.
   4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion (i.e. a navigation tree), such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.

C. Communication. Web server or workstation and controllers shall communicate using BacNet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BacNet/IP addressing as specified in ANSI/ASHRAE 135-2004, BacNet Annex J.

D. Hardware. A minimum of (1) workstation is to be provided per School as part of this contract in the Boiler Room or as directed by Owner.

E. Each workstation or web server shall consist of the following:
   1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 230900 Paragraph 1.9. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Appendix A, and a system database at least twice the size of the existing

database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server or workstations shall be IBM-compatible PCs with a minimum of:

a. Intel Pentium 2.66 GHz processor
b. 1 GB RAM
c. 40 GB hard disk providing data at 100 MB/sec

D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
   1. Log In and Log Out. System shall require user name and password to log in to operator interface.
   2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
   3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as set points, PID gains, on and off controls, and sensor calibration. Operators shall be able to drag color slide bars to increase heating and cooling set point, adjust dead bands, etc.
   4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display. Operators shall be able to select spaces, groups of spaces, buildings, or groups of buildings through the navigation tree to schedule all with one operation. The system shall allow customization of groups for this purpose. The operator shall only be required to know the space requiring a schedule. The system shall activate, at the appropriate time, all associated equipment needed to provide heating or cooling for that space (associated air-handlers, boilers, chillers, pumps, etc.).
   5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms. Operator shall be able to sort alarms through the hierarchical tree.
   6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points. Operators shall be able to select trends through the navigation tree, zoom, pan through historical data, and copy and paste pieces of data into spreadsheet programs.
   7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
   8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
   9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

E. System Software.
   1. Operating System. Web server shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.

2. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone set point.
    a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit set points and other specified parameters.
    b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
    c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
    d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).

F. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
    1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
    2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
    3. System Configuration. Operators shall be able to configure the system.
    4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
    5. Security. System shall require a username and password to view, edit, add, or delete data.
        a. Operator Access. Each username and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.
        b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
        c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
    6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
    7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as

specified in 230900 Appendix A (Sequences of Operation) – Sequence of Operations for HVAC Controls. Alarms shall be BacNet alarm objects and shall use BacNet alarm services.

8. Alarm Messages. Alarm messages shall use an English Language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 230900 Appendix A (Sequences of Operation. Trends shall be BacNet trend objects.
12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Standard Reports. Furnish the following standard system reports:
    a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
    b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
    c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
        i. Alarm History.
        ii. Trend Data. Operator shall be able to select trends to be logged.
        iii. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
16. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
17. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.

18. Graphic Demonstration Utility. Utility that enables operator to select system graphic screens to display, timing of screen changes, and order of viewing.
19. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming Language shall have the following features:
    a. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. The clarity of the graphic sequence must be such that an operator will not have to learn or interpret a manufacturer's unique programming Language.
    b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
    c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
    d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
    e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
    f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
    g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.
        i. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program Language.
        ii. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change set points of Controller Software as described in Controller Software section.

G. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.
H. BacNet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BacNet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2001, BacNet Annex L.

2.4 CONTROLLER SOFTWARE

A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.15.c (Operator Activity).
C. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
D. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:
    1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
    2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
    3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.
E. Optimum Start. Start and stop equipment on a sliding schedule based on the individual zone temperature and heating/cooling capacity in ° F/hour of the equipment serving that zone. The heating/cooling capacity value shall be operator adjustable. Temperature compensated peak demand limiting shall remain in effect during morning start up to avoid setting a demand peak.
F. Source Temperature Optimization
    1. The system shall automatically perform source optimization for all air handling units, chillers and boilers in response to the needs of other downstream pieces of equipment, by increasing or decreasing supply temperature set points, e.g. chilled water, discharge air, etc. using owner defined parameters. In addition to optimization, the STO capability shall also provide for starting and stopping primary mechanical equipment based on zone occupancy and/or zone load conditions.
    2. Set point Reset. The STO program will allow set points for equipment in the heating/cooling chain to be reset between an operator-defined maximum and a minimum set point based on the actual requirements of the building zones. The actual set point shall be calculated based on the number of heating or cooling requests which are currently being received from the equipment or zones served.
G. Timed Local Override. The system shall have TLO input points that permit the occupants to request an override of equipment that has been scheduled OFF. The system shall turn the equipment ON upon receiving a request from the local input device. Local input devices shall be push button (momentary contact), wind-up timer, or ON/OFF switches as detailed in the I/O summary.
H. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).
I. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).
J. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
K. Demand Limiting.
    1. System shall monitor building power consumption from building power meter pulse generator signals or from building feeder line watt transducer or current transformer.
    2. When power consumption exceeds adjustable levels, system shall automatically relax set points to pre-determined levels to reduce demand on the source equipment (ahu's, chillers, boilers, etc.), de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in 230900 Appendix A (Sequences of Operation). When demand drops below adjustable levels, system shall restore loads as specified.

L. There shall be two space temperature set points, one for cooling and one for heating, separated by a dead band. Only one of the two set points shall be operative at any time. The cooling set point is operative if the actual space temperature has more recently been equal to or greater than the cooling set point. The heating set point is operative if the actual space temperature has more recently been equal to or less than the heating set point. There are two modes of operation for the set points, one for the occupied mode (example: heating = 72°F or 22°C, cooling = 76°F or 24.4°C) and one for the unoccupied mode (example: heating = 55°F or 12.7°C, cooling = 90°F or 32°C).

M. Day/Night Setback
   1. The system shall allow the space temperature to drift up and down within a preset or adjustable unoccupied temperature range. The heating and cooling shall be activated upon reaching either end of the DNS range and shall remain activated until the space temperature returns to the DNS range.
   2. Outside & Exhaust Air. The system shall be capable of closing all outside air and exhaust air dampers during the unoccupied period, except for 100% outside air units.
   3. Unoccupied Space Temperature. Unoccupied space temperature shall be monitored by the DDC temperature sensors located in the individual zones being controlled or within a representative room.
   4. Parameter Changes. Operator shall be able to define, modify or delete the following parameters.
      A. DNS set point temperature(s)
      B. Temperature band for night heating operation
      C. Period when the DNS is to be activated

N. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in 230900 Appendix A (Sequences of Operation) – Sequence of Operations for HVAC Controls.

O. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in 230900 Appendix A (Sequences of Operation) – Sequence of Operations for HVAC Controls.

P. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, set point, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.

Q. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.

R. Energy Calculations.
   1. System shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
   2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

S. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

T. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and set point.

U. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in 230900 Appendix A (Sequences of Operation) – Sequence of Operations for HVAC Controls.

2.5 CONTROLLERS

A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 230900 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BacNet Device profile as specified in ANSI/ASHRAE 135-2004, BacNet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BacNet Smart Actuators and Smart Sensors.

B. BacNet.
   1. Building Controllers (BCs). Each BC shall conform to BacNet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135-2004, BacNet Annex L and shall be listed as a certified B-BC in the BacNet Testing Laboratories (BTL) Product Listing.
   2. Advanced Application Controllers (AACs). Each AAC shall conform to BacNet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135-2004, BacNet Annex L and shall be listed as a certified B-AAC in the BacNet Testing Laboratories (BTL) Product Listing.
   3. Application Specific Controllers (ASCs). Each ASC shall conform to BacNet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135-2004, BacNet Annex L and shall be listed as a certified B-ASC in the BacNet Testing Laboratories (BTL) Product Listing.
   4. Smart Actuators (SAs). Each SA shall conform to BacNet Smart Actuator (B-SA) device profile as specified in ANSI/ASHRAE 135-2004, BacNet Annex L and shall be listed as a certified B-SA in the BacNet Testing Laboratories (BTL) Product Listing.
   5. Smart Sensors (SSs). Each SS shall conform to BacNet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135-2004, BacNet Annex L and shall be listed as a certified B-SS in the BacNet Testing Laboratories (BTL) Product Listing.
   6. BacNet Communication.
      a. Each BC shall reside on or be connected to a BacNet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BacNet/IP addressing.
      b. BacNet routing shall be performed by BCs or other BacNet device routers as necessary to connect BCs to networks of AACs and ASCs.
      c. Each AAC shall reside on a BacNet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BacNet/IP addressing, or it shall reside on a BacNet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
      d. Each ASC shall reside on a BacNet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
      e. Each SA shall reside on a BacNet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
      f. Each SS shall reside on a BacNet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BacNet/IP addressing, or it shall reside on a BacNet network using ARCNET or MS/TP Data Link/Physical layer protocol.
      g. Controllers utilizing MS/TP protocol will not be allowed.

C. Communication.
   1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
   2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and viRTUal object information and to allow for central monitoring and alarms.
   3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.

4. Stand-Alone Operation. Each piece of equipment specified in 230900 Appendix A (Sequences of Operation) shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
   1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
   2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

E. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

F. Serviceability.
   1. Controllers shall have diagnostic LEDs for power, communication, and processor.
   2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
   3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

G. Memory.
   1. Controller memory shall support operating system, database, and programming requirements.
   2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
   3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
   4. Trend data shall be collected locally by controllers and periodically updated to the DDC server. Systems that rely on a gateway/router to run trends are NOT acceptable.

H. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

I. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.

C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.

E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

F. Binary Outputs. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights that are either built into the controller or mounted on the panel door. Switches shall be provided for all used and spare outputs. Outputs shall be selectable for normally open or normally closed operation.

G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights either built into the controller or mounted on the panel door. Switches and potentiometers shall be provided for all used and spare outputs. Analog outputs shall not drift more than 0.4% of range annually.

H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.7 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
   1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
      a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
      b. Line voltage units shall be UL recognized and CSA listed.

B. Power Line Filtering.
   1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
   b. Dielectric strength of 1000 V minimum
   c. Response time of 10 nanoseconds or less
   d. Transverse mode noise attenuation of 65 dB or greater
   e. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 AUXILIARY CONTROL DEVICES

A. Binary Temperature Devices.
   1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set point adjustment, 13°C-30°C (55°F-85°F) set point range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
   2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed set point

adjustment, 13°C-30°C (55°F-85°F) set point range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

B. Control Dampers, Motorized
   1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.
      a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
      b. Other modulating dampers shall be opposed-blade.
      c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
   2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 in.) extruded aluminum with reinforced corner bracing.
   3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
   4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
   5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 $L/s \cdot m^2$ (10 cfm per ft^2) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
   6. Sections. Damper sections shall not exceed 125 cm - 150 cm (48 in. - 60 in.). Each section shall have at least one damper actuator.
   7. Linkages. Dampers shall have exposed linkages.

C. Control Valves, Motorized
   1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
   2. Type. Provide two- or three-way control valves for two-position or modulating service as shown.
   3. Water Valves.
      a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.
      b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
         i. Two-way: 150% of total system (pump) head.
         ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
      c. Ports. Valves providing modulating service shall have equal percentage ports.
      d. Sizing.
         i. Two-position service: line size.
         ii. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).
         iii. Three-way modulating service: select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi).

iv. For high-pressure bypass valves for heating or chilled water system, the control contractor shall size the valve for 25% of the system flow indicated on the schedule. The bypass set point shall be the head rating indicated on the pump curve (contact engineer for advice on submitted pump) for that pump.

e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
   i. Water zone valves: normally open.
   ii. Heating coils in air handlers: normally open.
   iii. Chilled water control valves: normally closed.
   iv. Reheat valves: normally closed.
   v. Other applications: as scheduled or as required by sequences of operation.

D. Current Switches.
   1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

E. Current Transformers.
   1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
   2. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.
   3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

F. Damper and Valve Actuators, Electric
   1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
   2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
   3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
   4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
   5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
   6. Actuators to be of sufficient size to operate device safely and within the required range.
   7. Fail Position. Dampers shall fail normally open or closed as follows unless otherwise specified.
      a. Outside air dampers: normally closed.
      b. Return air dampers: normally open.
      c. Exhaust air dampers: normally closed.
      d. Fire/Smoke dampers: normally closed.
      e. VAV terminal dampers: normal open.

G. Enclosures, Controller
   1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.

2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

H. Humidity Sensors.
1. Duct and room sensors shall have a sensing range of 20%-80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°C-75°C (40°F-170°F).
4. Humidity sensors shall not drift more than 1% of full scale annually.
5. Each pneumatic signal line to PE switches shall have permanent indicating gauge.

I. Pressure Transducers.
1. Transducers shall have linear output signal and field-adjustable zero and span.
2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.

4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

J. Relays.
1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from set point shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

K. Temperature Sensors
1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m ^{2}(10 ft ^{2}) of duct cross-section.
3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
4. Space Sensors. Space sensors shall have set point adjustment, override switch, display, and communication port as shown.
5. Differential Sensors. Provide matched sensors for differential temperature measurement.

L. Voltage Transformers.
1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

N. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

2. 09 WIRING AND RACEWAYS

A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 230900 work with work of others.

3.2 COORDINATION

A. Site.
1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
B. Submittals. See Section 230900 Article 1.10 (Submittals).
C. Test and Balancing.
1. Provide Test and Balancing Contractor a single set of necessary tools to interface to control system for testing and balancing.
2. Train Test and Balancing Contractor to use control system interface tools.
3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
4. Test and Balancing Contractor shall return tools undamaged and in working condition at completion of testing and balancing.
D. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.

1. Communication media and equipment shall be provided as specified in Section 230900 Article 2.2 (Communication).
2. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation described in 230900 Appendix A (Sequences of Operation) Appendix A regardless of where within the contract documents those products are described.
3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. Controls Contractor shall be responsible for integration of control products (if specified in the control sequences or elsewhere) provided by multiple suppliers regardless of where integration is described within the contract documents.

3.3 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.4 FIELD QUALITY CONTROL

A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 230900 Article 1.8 (Codes and Standards).
B. Continually monitor field installation for code compliance and workmanship quality.
C. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.5 WIRING

A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 16, and manufacturer's recommendations. Where the requirements of Section 230900 differ from Division 16, Section 230900 shall take precedence.
B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 16.
C. Low-voltage wiring shall meet NEC Class 2 requirements. Sub fuse low-voltage power circuits as required to meet Class 2 current limit.
D. NEC Class 2 (current-limited) wires may be run exposed in concealed and accessible locations such as return air plenums and shall be UL listed for the intended application.
E. Install Class 2 cables and wiring in approved raceway where subject to mechanical damage and at levels below 3 m (10ft) in mechanical, electrical, service rooms, or occupied spaces.
F. Use structural members to support or anchor exposed Class 2 cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.

G. Run exposed Class 2 cables parallel to a surface or perpendicular to it and tie neatly at 3 m (10 ft) intervals.
H. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
I. Do not install wiring in raceway containing tubing.
J. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
K. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
L. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
M. Use color-coded conductors throughout.
N. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
O. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
P. Adhere to requirements in Division 16 where raceway crosses building expansion joints.
Q. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
R. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
S. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
T. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.6 INSTALLATION OF SENSORS

A. Install sensors according to manufacturer's recommendations.
B. Mount sensors rigidly and adequately for operating environment.
C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
D. Install room temperature sensors in locations indicated on drawings. Unless otherwise noted, install devices 48 inches above the floor.
E. Install guards on room equipment (e.g. sensors) in the following locations:
    1. Entrances
    2. Public areas
    3. Where indicated
F. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
G. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
H. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 3 m (1 ft) of sensing element for each 1 m^2 (1 ft^2) of coil area.

I. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
J. Install outdoor air temperature sensors on north wall at designated location with sun shield.
K. Differential Air Static Pressure.
    1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
    2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
    3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
    4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
    5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
    6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
L. Smoke detectors, freeze stats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.7 FLOW SWITCH INSTALLATION

A. Use correct paddle for pipe diameter.
B. Adjust flow switch according to manufacturer's instructions.

3.8 ACTUATORS

A. General. Mount actuators and adapters according to manufacturer's recommendations.
B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
    1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
    2. To compress seals when spring-return actuators are used on normally closed dampers, power actuators to approximately 5° open position, manually close the damper, then tighten linkage.
    3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
    4. Provide necessary mounting hardware and linkages for actuator installation.
C. Valve Actuators. Connect actuators to valves with adapters approved by actuator manufacturer.

3.9 WARNING LABELS

A. Affix permanent warning labels to equipment that can be automatically started by the control system.
    1. Labels shall use white lettering (12-point type or larger) on a red background.
    2. Warning labels shall read as follows.

C A U T I O N
This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
   1. Labels shall use white lettering (12-point type or larger) on a red background.
   2. Warning labels shall read as follows.

C A U T I O N
This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.10 IDENTIFICATION OF HARDWARE AND WIRING

A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.
C. Permanently label or code each point of field terminal strips to show instrument or item served.
D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
F. Label room sensors related to terminal boxes or valves with nameplates.
G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
H. Label identifiers shall match record documents.

3.11 PROGRAMMING

A. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See 230900 Appendix A (Sequences of Operation) (Sequences of Operation). If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to 230900 Appendix A (Sequences of Operation) may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.
B. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented. Text-based programs shall be modular, structured, and commented to clearly describe each section of the program.
   1. Application Programming. Provide application programming that adheres to sequences of operation specified in 230900 Appendix A (Sequences of Operation). Program documentation or comment statements shall reflect Language used in sequences of operation.
   2. System Programming. Provide system programming necessary for system operation.
C. Operator Interface.
   1. Standard Graphics. Provide graphics as specified in Section 230900 Article 2.3 Paragraph E.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List in

230900 Appendix A (Sequences of Operation). Point information on graphics shall dynamically update.

2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in Section 230900.

3.12 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
   1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 230900.
   2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
   3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
   4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
   5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
   6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
   7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
   8. Alarms and Interlocks.
      a. Check each alarm with an appropriate signal at a value that will trip the alarm.
      b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
      c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.13 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.17 (Control System Checkout and Testing). Provide Engineer with log documenting completion of startup tests.
   1. Engineer will be present to observe and review system demonstration. Notify Engineer at least 10 days before system demonstration begins.
   2. Demonstration shall follow process submitted and approved under Section 230900 Article 1.10 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.
   3. Demonstrate actual field operation of each sequence of operation as specified in 230900 Appendix A (Sequences of Operation). Provide at least two persons equipped with two-

way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.

4. Demonstrate compliance with Section 230900 Part 1 (System Performance).
5. Demonstrate compliance with sequences of operation through each operational mode.
6. Demonstrate complete operation of operator interface.
7. Demonstrate each of the following.
    a. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a set point change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show set point, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
    b. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting set point, and status of set points and other affected equipment parameters.
    c. Building fire alarm system interface.
    d. Trend logs for each system. Trend data shall indicate set points, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in 230900 Appendix A (Sequences of Operation). Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 230900 Article 2.3 Paragraph E.11 (Trend Configuration).
8. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance.
    1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
    2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 230900 Article 1.10 (Submittals).

3.14 CLEANING

A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

3.15 TRAINING

A. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods. Training shall include a minimum of 4 hours of on-site instruction.
B. Training shall enable students to accomplish the following objectives.
    1. Proficiently operate system
    2. Understand control system architecture and configuration
    3. Understand DDC system components
    4. Understand system operation, including DDC system control and optimizing routines (algorithms)
    5. Operate workstation and peripherals
    6. Log on and off system
    7. Access graphics, point reports, and logs
    8. Adjust and change system set points, time schedules, and holiday schedules
    9. Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
    10. Understand system drawings and Operation and Maintenance manual
    11. Understand job layout and location of control components
    12. Access data from DDC controllers
    13. Operate portable operator's terminals
    14. Create and change system graphics
    15. Create, delete, and modify alarms, including configuring alarm reactions
    16. Create, delete, and modify point trend logs (graphs) and multi-point trend graphs
    17. Configure and run reports
    18. Add, remove, and modify system's physical points
    19. Create, modify, and delete application programming
    20. Add operator interface stations
    21. Add a new controller to system
    22. Download firmware and advanced applications programming to a controller
    23. Configure and calibrate I/O points
    24. Maintain software and prepare backups
    25. Interface with job-specific, third-party operator software
    26. Add new users and understand password security procedures
C. Divide presentation of objectives into three sessions (1-13, 14-23, and 24-26). Participants will attend one or more of sessions, depending on knowledge level required.
    1. Day-to-day Operators (objectives 1-13)
    2. Advanced Operators (objectives 1-13 and 14-23)
    3. System Managers and Administrators (objectives 1-13 and 24-26)
D. Provide course outline and materials according to Section 230900 Article 1.10 (Submittals). Provide one copy of training material per student.
E. Instructors shall be factory-trained and experienced in presenting this material.
F. Perform classroom training using a network of working controllers' representative of installed hardware.

APPENDIX A: Sequences of Operation – See Mechanical Drawings

GENERAL

- Scheduling of the occupied and unoccupied modes shall be controlled through Union College's existing Honeywell Control System. All equipment shall start prior to scheduled occupancy based on the time necessary for the zones to reach their occupied set points. The start time shall automatically adjust based on changes in outside air temperature and zone temperatures.
- When scheduling the system, the occupant shall only be required to know the zone or pre-determined grouping of zones to be scheduled. All other equipment that is needed to operate to serve that zone shall be activated by the BAS.
- Any set points (degrees, psig, minutes, etc.) shall be adjustable by the User.
- All Digital Outputs (DO's) shall have a manual Hand-Off-Auto switch built into the DDC controller board to override automatic operation. The switch position shall provide feedback to the DDC Controller to indicate the switch positions. If the DDC controller does not have a built-in HOA switch, a panel face manual H-O-A switch with a label shall be provided and all positions shall input to Digital inputs to indicate the position and enable or disable control loops.
- The controller for all equipment shall operate on the peer-to-peer network (no MS/TP), share no programming with a Master Controller (point of failure) and shall communicate at the same speed as all other controllers in the system. All controllers shall be capable of full standalone operation including time-scheduling and trend data capabilities.
- It shall be possible from the Web Control Server, any Web-based Browser, wireless web-enabled device, or LCD keypad, to view the status of the all points and any others needed to accomplish the sequences shown on the drawings.
- It shall be possible from the Web Control Server, any Web-based Browser, wireless web-enabled device, or LCD keypad, to view and adjust all programming, scheduling, trending, reports, alarms, and network maintenance. This includes the following:
    - All zone temperature conditions, occupied and unoccupied states, and network status shall display on a color-coded floor plan graphic. All set points noted above shall be adjustable via the system graphics.
    - All points shall have trends configured and available through the system graphics.
    - Systems shall be scheduled through the graphics in a hierarchical fashion.
    - All programming logic shall be viewable and adjustable via the system graphics.
    - In addition to any alarms specifically called out in the individual sequence sections below, all points shall have alarms, at the discretion of the owner and engineer, indicated on the system with priorities and presentation options (e.g. available through email, paging, etc.) configured with limits set to suit the needs of the Owner and the requirements of the engineer.

APPENDIX B: Glossary of Terms

Terms used within the Specification Text:

- Advanced Application Controller (AAC):

  A fully programmable control module. This control module may be capable of some of the advanced features found in Building Controllers (storing trends, initiating read and write requests,

etc.) but it does not serve as a master controller. Advanced Application Controllers may reside on either the Ethernet/IP backbone or on a subnet.

- Application Specific Controller (ASC):

  A pre-programmed control module which is intended for use in a specific application. ASCs may be configurable, in that the user can choose between various pre-programmed options, but it does not support full custom programming. ASCs are often used on terminal equipment such as VAV boxes or fan coil units. In many vendors' architectures ASCs do not store trends or schedules but instead rely upon a Building Controller to provide those functions.

- BacNet/IP:

  An approved BacNet network type which uses an Ethernet carrier and IP addressing.

- BacNet MS/TP:

  A BacNet network type (not approved for this project) which uses a Master-Slave Token Passing configuration. MS/TP networks are unique to BacNet and utilize EIA485 twisted pair topology running at 9600 to 76,800 bps.

- BacNet over ARCNET:

  An approved BacNet network type which uses an ARCNET (attached resource computer network) carrier. ARCNET is an industry standard that can utilize several speeds and wiring standards. The most common configuration used by BacNet controllers is an EIA485 twisted pair topology running at 156,000 bps.

- Building Controller (BC):

  A fully programmable control module which is capable of storing trends and schedules, serving as a router to devices on a subnet, and initiating read and write requests to other controllers. Typically this controller is located on the Ethernet/IP backbone of the DDC. In many vendors' architectures a Building Controller will serve as a master controller, storing schedules and trends for controllers on a subnet underneath the Building Controller.

- Direct Digital Control (DDC):

  A control system in which a digital computer or microprocessor is directly connected to the valves, dampers, and other actuators which control the system, as opposed to indirectly controlling a system by resetting set points on an analog pneumatic or electronic controller.

- PICS - Protocol Implementation Conformance Statement:

  A written document, created by the manufacturer of a device, which identifies the particular options specified by BacNet that are implemented in the device.

- Smart Actuator (SA):

An actuator which is controlled by a network connection rather than a binary or analog signal. (0-10v, 4-20mA, relay, etc.)

- Smart Sensor (SS):

  A sensor which provides information to the DDC via network connection rather than a binary or analog signal. (0-10000 ohm, 4-20mA, dry contact, etc.)

- Web services:

  Web services are a standard method of exchanging data between computer systems using the XML (extensible markup Language) and SOAP (simple object access protocol) standards. Web services can be used at any level within a Building Management System (DDC), but most commonly they are used to transfer data between DDC using different protocols or between a DDC and a non-DDC system such as a tenant billing system or a utility management system.

Terms used within the Sequences of Operation:

- adj. Adjustable by the end user, through the supplied user interface.
- AI, AO, etc. (Column Headings on Points List)

- AI = Analog Input. A physical input to the control module.
- AO = Analog Output. A physical output from the control module.
- AV = Analog Value. An intermediate (software) point that may be editable or read-only. Editable
- AVs are typically used to allow the user to set a fixed control parameter, such as a set point. Read Only AVs are typically used to display the status of a control operation.
- BI = Binary Input. A physical input to the control module.
- BO = Binary Output. A physical output from the control module.
- BV = Binary Value. An intermediate (software) point that may be editable or read-only. Editable BVs are typically used to allow the user to set a fixed control parameter, such as a set point.
- Read Only BVs are typically used to display the status of a control operation.
- Sched = Schedule. The control algorithm for this equipment shall include a user editable schedule.
- Trend. The control system shall be configured to collect and display a trend log of this object. The trending interval shall be no less than one sample every 5 minutes. (Change of Value trending, where a sample is taken every time the value changes by more than a user-defined minimum, is an acceptable alternative.)
- Alarm. The control system shall be configured to generate an alarm when this object exceeds user definable limits, as described in the Sequence of Controls.

  Note: If the specifications require use of the BacNet protocol, all of the above shall be provided as BacNet objects.

- KW Demand Limiting: *

  An energy management strategy that reduces energy consumption when a system's electric power meter exceeds an operator-defined threshold. When power consumption exceeds defined levels, the system automatically adjust set points, de-energizes low priority equipment, and takes other

pre-programmed actions to avoid peak demand charges. As the demand drops, the system restores loads in a predetermined manner.

- Occupant Override Switch or Timed Local Override: A control option that allows building occupants to override the programmed HVAC schedule for a limited period of time.

  When the override time expires, the zone returns to its unoccupied state.

- Occupant Set point Adjustment:

  A control option that allows building occupants to adjust - within limits set by the HVAC control system - the heating and cooling set points of selected zones. Typically the user interface for this function is built into the zone sensor.

- Optimal Start-Up: *

  A control strategy that automatically starts an HVAC system at the latest possible time yet ensures comfort conditions by the time the building becomes occupied.

  In a typical implementation, a controller measures the temperature of the zone and the outside air. Then, using design heating or cooling capacity at the design outside air temperature, the system computes how long a unit must run at maximum capacity to bring the zone temperature to its occupied set point.

  The optimal start algorithm often includes a self-learning feature to adjust for variations from design capacity.

  A distributed system must use Run on Request with Optimal Start. (See below.)

- Requested, or Run on Request: *

  A control strategy that optimizes the runtime of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service. Source equipment runs only when needed, not on a fixed schedule.

  The source equipment runs when one or more receiving units request its services. An operator determines how many requests are required to start the source equipment.

  For example, if all the zones in a building are unoccupied and the zone terminal units do not need heating or cooling, the AHU will shut down. However, if a zone becomes occupied or needs cooling, the terminal unit will send a run request to the AHU to initiate the start-up sequence. If this AHU depends on a central chiller, it can send a run request to the chiller.

  The run on request algorithm also allows an operator to schedule occupancy for individual zones based on the needs of the occupants without having to adjust the schedules of related AHUs and chillers.

- Trim and Respond, or Set point Optimization: *

A control strategy that optimizes the set point of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service.

The source unit communicates with receiving units to determine heating, cooling, and other requirements, and then adjusts its set point.

For example, if all zones are comfortable and do not request cooling, the AHU will gradually increase (trim) its supply air set point. When a zone requests cooling, the AHU responds by dropping its set point. The more zones that request cooling, the more it drops the set point. The AHU repeats this process throughout the day to keep zones cool, but with a supply air set point that is no cooler than necessary.

Contracting Terms:

- Furnished or Provided:

  The act of supplying a device or piece of equipment as required meeting the scope of work specified and making that device or equipment operational. All costs required to furnish the specified device or equipment and make it operational are borne by the division specified to be responsible for providing the device or equipment.

- Install or Installed:

  The physical act of mounting, piping or wiring a device or piece of equipment in accordance with the manufacturer's instructions and the scope of work as specified. All costs required to complete the installation are borne by the division specified to include labor and any ancillary materials.

- Interface:

  The physical device required to provide integration capabilities from an equipment vendor's product to the control system. The equipment vendor most normally furnishes the interface device. An example of an interface is the chilled water temperature reset interface card provided by the chiller manufacturer in order to allow the control system to integrate the chilled water temperature reset function into the control system.

- Integrate:

  The physical connections from a control system to all specified equipment through an interface as required to allow the specified control and monitoring functions of the equipment to be performed via the control system.

APPENDIX C: Abbreviations

The following abbreviations may be used in graphics, schematics, point names, and other UI applications where space is at a premium.

AC - Air Conditioning
ACU - Air Conditioning Unit
AHU - Air Handling Unit

AI - Analog Input
AO - Analog Output
AUTO - Automatic
AUX - Auxiliary
BI - Binary Input
BO - Binary Output
C - Common
CHW - Chilled Water
CHWP - Chilled Water Pump
CHWR - Chilled Water Return
CHWS - Chilled Water Supply
COND - Condenser
CW - Condenser Water
CWP - Condenser Water Pump
CWR - Condenser Water Return
CWS - Condenser Water Supply
DA - Discharge Air
EA - Exhaust Air
EF - Exhaust Fan
EVAP - Evaporators
FCU - Fan Coil Unit
HOA - Hand / Off / Auto
HP - Heat Pump
HRU - Heat Recovery Unit
HTEX - Heat Exchanger
HW - Hot Water
HWP - Hot Water Pump
HWR - Hot Water Return
HWS - Hot Water Supply
MAX - Maximum
MIN - Minimum
MISC - Miscellaneous
NC - Normally Closed
NO - Normally Open
OA - Outdoor Air
PIU - Powered Induction Unit
RA - Return Air
RF - Return Fan
RH - Relative Humidity
RTU - Roof-top Unit
SA - Supply Air
SF - Supply Fan
SP - Static Pressure
TEMP - Temperature
UH - Unit Heater
UV - Unit Ventilator
VAV - Variable Air Volume
VVTU - Variable Volume Terminal Unit
W/ - with
W/O - without
WSHP - Water Source Heat Pump

END OF SECTION 230900

SECTION 232113 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Condensate-drain piping.
3. Blowdown-drain piping.
4. Air-vent piping.
5. Safety-valve-inlet and -outlet piping.

B. Related Sections include the following:

1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: 125 psig at 200 deg F.
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Blowdown-Drain Piping: 200 deg F.
5. Air-Vent Piping: 200 deg F.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. Pressure-seal fittings.
3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
4. Air control devices.
5. Chemical treatment.
6. Hydronic specialties.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Grooved joint couplings and fittings shall be referred to on drawings and product submittals, and be identified by the manufacturer’s listed model or series designation

D. Welding certificates.

E. Qualification Data: For Installer.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

H. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

E. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.

1. Grooved-End Copper Fittings: ASME B16.22 wrought copper and ASTM B 75, copper tube or ASME B16.18 and ASTM B 584, bronze casting. Manufactured to copper tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.) Basis of Design: Victaulic Copper Connection.
2. Grooved-End-Tube Couplings: Rigid pattern with offsetting angle-pattern bolt pads, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching copper-tube and fitting grooves, EPDM-HP center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth, rated for minimum 230 deg F for use with housing, and ASTM A449 compliant steel bolts and nuts. Installation-Ready, for direct stab installation without field disassembly. Basis of Design: Victaulic Style 607.
3. Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.

E. Wrought-Copper Unions: ASME B16.22.

F. Copper or Bronze Pressure-Seal Fittings:
1. Manufacturers: All boiler venting shall be furnished by the boiler manufacturer. Subject to compliance with requirements, provide products by one of the following:
    a. Mueller Industries, Inc
    b. Nibco Inc.
    c. Viega LLC
    d. Or approved equal.
2. Housing: Copper.
3. O-Rings and Pipe Stops: EPDM.
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig working-pressure rating at 250 deg F.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Installation-Ready™ fittings for Schedule 10 through Schedule 80 plain end carbon steel piping in sizes NPS ½" thru 2" (DN15 thru DN50), rated for working pressure of 300 psi (2065 kPa). Fittings shall consist of a ductile iron housing with Installation-Ready™ ends**,** gasket liner, zinc-electroplated steel bolts and nuts, and 300 series stainless steel retainer. Basis of Design: Victaulic QuickVic™ SD.

F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

I. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Victaulic Company.

1. Operating Conditions: -30° F through +250° F temperature range according to gasket or valve lining selected and working pressure as shown in manufacturer's current product specification.

2. Couplings

a. Two segments, cast of ductile iron conforming to ASTM A 536. Alkyd enamel coating for black steel piping systems. Galvanized finish for galvanized piping systems. Couplings designed to engage and lock grooved or shouldered piping and fitting ends.

a. Sizes 2 inches through 12 inches: Coupling housings cast with torque-absorber and shift-limiting offsetting, angle pattern bolt pads to provide system rigidity and

support and hanging in accordance with ANSI B31.1 and B31.9, and to prevent mis-assembly due to overshift. Housings cast with alignment indicator notch for visual proper alignment to adjoining fitting. Installation-Ready™, for direct stab installation without field disassembly, with grade EHP center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth. suitable for water service to +250 deg F. Basis of Design: Victaulic Style 107V.

b. Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for the elimination of flexible connectors. Victaulic Installation-Ready Style 177 or Style 77.

c. AGS two-segment couplings for pipe sizes 14” and larger, with wide-width FlushSeal® gasket and lead-in chamfer on housing key. Basis of Design: Victaulic Style W07 (rigid) and Style W77 (flexible).

3. Gaskets composed of elastomer properties as designated by ASTM D 2000. Gaskets for water service Grade "E" EPDM, with green color code.

4. Coupling Assembly: Housing clamps in two parts, single C-shaped gasket, two or more ASTM A449 electroplated steel bolts as required to assemble housing clamps.

5. Fittings: Full flow type fittings with grooves designed to accept couplings of the same manufacturer. ASTM A 536 cast ductile iron, ASTM A234 forged steel, or ASTM A53 factory-fabricated carbon steel, galvanized for galvanized piping systems.

a. QuickVic 2” through 12” (DN50 through DN300); ASTM A536 Grade 65-45-12 ductile iron with Victaulic Original Grooved System (OGS) grooved ends, stiffening ribs, and alignment indicators, orange coated or hot dipped galvanized as per ASTM A123, working pressure 400-psi (2758-kPa). Victaulic QuickVic™ V10 (90-deg), V11 (45-deg), and V20 (tee).

2.3 PLASTIC PIPE AND FITTINGS

A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

C. Victaulic Company PGS-300 Piping system may be used where approved IPS size PVC pipe is approved for use. Pipe and fittings shall be cut grooved to Victaulic’s PGS-300 groove specification.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Grooved Joint Lubricants: If required, lubricate gasket in accordance with the manufacturer's published instructions with lubricant approved for the gasket elastomer and fluid media. Basis of Design: Victaulic Vic-Lube.

H. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

I. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Pipeline Seal and Insulator, Inc.

c. Or approved equal.

2. Description:

   a. Nonconducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150 psig.
   c. Gasket: Neoprene or phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.

C. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Victaulic Company of America.

   b. Or approved equal.

2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
3. Copper-silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with ANSI / NSF-61 for potable water service. Basis of Design: Victaulic Style 647.

2.6 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Y-Pattern Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Victaulic/Tour & Andersson

      1) 300 PSI Series 786, 787 & 78K (soldered or threaded ends).
      2) 250 PSI Series 788 & 789 (flanged or grooved ends).

   b. Armstrong.
   c. Wheatley.

   d. Or approved equal.

2. Use for throttling in water service 1/2” to 16”.
3. Provide valves of Y-Pattern design suitable for water temperatures to 250ºF. Provide valves with provision for connecting a portable differential pressure meter. Each meter connection to have pressure/temperature readout points.

4. Construct valves up to 2” of pressure die cast nonporous Ametal® copper alloy providing dielectric protection and 2-1/2” and over of ductile iron body and Ametal® non ferrous copper alloy internal components.
5. Valves to be omnidirectional without affecting flow measurement and shall provide precise flow measurement, precision flow balancing, positive shut-off with no drip seat.
6. Construct valves so that 4, 8, 12, 16, 20 or 22 full turns of handwheel provides maximum setting with hidden memory feature and tamper proof balancing setting.
7. Coil Components: Install with balancing valves 2” and smaller, Victaulic Series 78U union port fitting, Series 78Y strainer/ball valve or Series 78T union/ball valve combination. Victaulic Series 799 or Series 79V with ATC valve.
8. Provide TA CM 73M computerized flow reading kit compatible with valve flow reading kits to be handed over to the owner.

2.7 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.
5. Or approved equal.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

D. Bladder-Type ASME Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Tangential-Type Air Separators:
   1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
   2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
   3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
   4. Blowdown Connection: Threaded.
   5. Size: Match system flow capacity.

2.8 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
   1. Body:
      a. ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
      b. ASTM A 536, Grade 65-45-12, ductile iron with coupled cover.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger. Grooved end Y-pattern strainer, Victaulic 732, also acceptable.
   3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
   4. CWP Rating: 300 psig.

B. Grooved End T-Type Strainer. 2" through 12" sizes, 300 PSI ductile iron body, or factory-manufactured from ASTM A53 steel pipe with T-bolt hinged closure, Type 304 stainless steel perforated metal removable baskets. Victaulic Style 730.

C. Stainless-Steel Bellow, Flexible Connectors:

   1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
   2. End Connections: Threaded or flanged to match equipment connected.
   3. Performance: Capable of 3/4-inch misalignment.
   4. CWP Rating: 150 psig.
   5. Maximum Operating Temperature: 250 deg F.
   6. Three Victaulic flexible type couplings may be used in lieu of a flexible connector for vibration attenuation at equipment connections in applicable piping systems. The couplings shall be placed in close proximity to the source of the vibration.

D. Manufactured grooved end vibration isolation drop for air handling unit coil supply and return connections in sizes 2" through 6" (DN50 though DN150) to accommodate isolation, straining, balancing, and drainage. Orange enamel coated drop, consisting of ASTM A53 carbon steel pipe spool(s), Victaulic #20 (straight) and #25 (reducing) tees or Style 920/920N Mechanical-T fittings, with base end cap with drain outlet and DZR brass drain valve. Supply connections include a Vic-300 MasterSeal butterfly valve and Style 732 Y-pattern strainer with PT ports, and the return connection includes a Series 787 or 789 circuit balancing valve. Installation-ready, with flexible couplings to accommodate vibration attenuation and stress relief, rated for working pressure to 300-psig (2068-kPa). Basis of Design: Victaulic Series 385 or approved equal.

E. Manufactured grooved end outlet fitting all-in-one assembly for fluid distribution. Outlet fitting shall consist of an ASTM A53, Grade B, standard weight pipe spool with required outlet connections. Grooved ends roll grooved to Victaulic [OGS] [AGS] dimensions, with enamel coating or galvanized to project requirements. Basis of Design: Victaulic No. 26 and W26 or approved equal.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints for all indoor piping. Schedule 40 PVC plastic pipe and fittings and solvent-welded joints for rooftop units outdoor only.

D. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

E. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with pressure-sealed or flared joints.

F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

Q. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

R. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

S. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

T. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

U. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

V. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 10 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 10 feet; minimum rod size, 1/2 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

A. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings unless flexibility is required. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved coupling manufacturer’s factory trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools, application of

groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

B. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

D. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

3.9 CHEMICAL TREATMENT

A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:

1. pH: 9.0 to 10.5.
2. "P" Alkalinity: 100 to 500 ppm.
3. Boron: 100 to 200 ppm.
4. Chemical Oxygen Demand: Maximum of 100 ppm.
5. Corrosion Inhibitor:

    a. Sodium Nitrate: 1000 to 1500 ppm.
    b. Molybdate: 200 to 300 ppm.
    c. Chromate: 200 to 300 ppm.
    d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
    e. Chromate Plus Molybdate: 50 to 100 ppm each.

6. Soluble Copper: Maximum of 0.20 ppm.
7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum of 10 ppm.
8. Total Suspended Solids: Maximum of 10 ppm.
9. Ammonia: Maximum of 20 ppm.

10. Free Caustic Alkalinity: Maximum of 20 ppm.
11. Microbiological Limits:

    a. Total Aerobic Plate Count: Maximum of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maximum of 100 organisms/mL.
    c. Nitrate Reducers: 100 organisms/mL.
    d. Sulfate Reducers: Maximum of zero organisms/mL.
    e. Iron Bacteria: Maximum of zero organisms/mL.

B. Install bypass chemical feeders in each hydronic system where indicated.

1. Install in upright position with top of funnel not more than 48 inches above the floor.
2. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
3. Install NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.

C. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

E. Prior to supplying water to the Water-source Heat Pump the Water Treatment Specification shall be consulted for requirements regarding the water quality during Chiller/Heater operation. The appropriate Water-source Heat Pump manufacturer’s service literature shall be available to the operator and/or service contractor and consulted for guidelines concerning preventative maintenance and off-season shutdown procedures.

END OF SECTION 232113

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-32:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Hot-Gas and Liquid Lines: 535 psig.

1.4 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Filter dryers.
4. Strainers.
5. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Welding certificates.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

D. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

E. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.

7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig.

F. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

G. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

H. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

I. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.
5. Or approved equal.

C. ASHRAE 34, R-32: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-32

A. Suction Lines NPS 3-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

B. Hot-Gas and Liquid Lines: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

D. Install a full-sized, three-valve bypass around filter dryers.

E. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

F. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

G. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

H. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

I. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Compressor.

J. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

K. Install receivers sized to accommodate pump-down charge.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Install refrigerant piping in protective conduit where installed belowground.

L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

M. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

N. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

P. Install sleeves for piping penetrations of walls, ceilings, and floors.

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.

2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

D. Welding certificates.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.
    d. Sheet Metal Connectors, Inc.
    e. Spiral Manufacturing Co., Inc.
    f. Or approved equal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corporation; Insulation Group.
    b. Johns Manville.
    c. Knauf Insulation.
    d. Owens Corning.
    e. Or approved equal.

2. Maximum Thermal Conductivity:

    1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

    a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.

b. Intervals of lined duct preceding unlined duct.

8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections[, selected by Architect from sections installed,] totaling no less than 25 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.

5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.

5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:

   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 3.
   d. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 3.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

E. Liner Schedule:

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
3. Supply Fan Plenums: Fibrous glass, Type II, 1 inch thick.
4. Provide acoustical lining 15 ft. upstream and downstream of all air handling equipment on supply and return ductwork, whether indicated on the drawings or not. Air handling equipment includes, but is not limited to, air handling units, roof top units. If a branch takeoff occurs in the 15 ft., line entire takeoff. Provide acoustical lining for all outside air plenums, return air plenums and transfer ducts.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

1.3 SUBMITTALS

A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Wiring Diagrams: For power, signal, and control wiring.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

C. Source quality-control reports.

D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Potorff.
3. Ruskin Company.
4. Or approved equal.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 1-inch wg.

E. Frame: 0.052-inch thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Nonferrous metal.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: 20-gage minimum.
    b. Sleeve Length: 6 inches minimum.
6. Screen Material: Galvanized steel.
7. Screen Type: Insect.
8. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. McGill AirFlow LLC.
    b. Pottorff; a division of PCI Industries, Inc.
    c. Ruskin Company.
    d. Or approved equal.
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Hat shaped.
    b. Galvanized-steel channels, 0.064 inch thick.
    c. Mitered and welded corners.
    d. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized, roll-formed steel, 0.064 inch thick.

6. Blade Axles: Nonferrous metal.
7. Bearings:

    a. Oil-impregnated bronze.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Blade Seals: Neoprene.
9. Jamb Seals: Cambered stainless steel.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

2.4 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.
4. Or approved equal.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 2-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.138-inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.024-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
4. Or approved equal.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. SEMCO Incorporated.
4. Or approved equal.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. Or approved equal.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.
4. Or approved equal.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
5. Or approved equal.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.

4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. At each change in direction and at maximum 50-foot spacing.
7. Upstream and downstream from turning vanes.
8. Upstream or downstream from duct silencers.
9. Control devices requiring inspection.
10. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.
4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 – HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. In-line above ceiling mounted ventilators.
   2. Centrifugal ventilators - roof downblast

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

   1. Roof framing and support members relative to duct penetrations.
   2. Ceiling suspension assembly members.

3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.6 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

1.8 WARRANTY

A. Manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of two years from substantial completion. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 - PRODUCTS

2.1 IN-LINE, SQUARE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.
4. Or approved equal.

B. Housing: Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.

C. Housing Supports and Drive Frame: Housing supports are constructed of structural steel with formed flanges. Drive frame is welded steel which supports the motor.

D. Direct-Drive Units: Electronically commutated motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Fan Wheels: Aluminum, backward inclined. Statically and dynamically balanced in accordance to AMCA Standard 204-05. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.

F. Finish: Permatector, thermo-setting polyester urethane.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: NEMA 1, positive electrical shut-off, wired from fan motor to junction box.
3. Access Panel: Two sided access panels, located perpendicular to the motor mounting panel.
4. Companion Flanges: For inlet and outlet duct connections.
5. Vibration Isolators:

    a. Type: Elastomeric hangers.
    b. Static Deflection: 1 inch.

2.2 CENTRIFUGAL VENTILATORS - ROOF DOWNBLAST

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.

3. PennBarry.
4. Or approved equal.

B. Housing: Downblast; removable spun-aluminum dome top and outlet baffle; square, one-piece aluminum base with venturi inlet cone.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Accessories:

1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Spark-resistant, all-aluminum wheel construction.

E. Prefabricated Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 18 inches (450 mm).
3. Sound Curb: Curb with sound-absorbing insulation.
4. Hinged sub-base to provide access to damper or as cleanout for grease applications.
5. Metal Liner: Galvanized steel.

2.3 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with performance requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:
1. Refer to scheduled accessories on contract drawings

2.4 MOTORS

A. Comply with requirements in Division 23 Section "Motors."

B. Enclosure Type: Totally enclosed, fan cooled.

C. ECM Type: Comply with requirements in Division 23 Section "Motors."

2.5 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

C. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Rectangular and square ceiling diffusers
2. Adjustable bar registers
3. Fixed face registers
4. Spiral duct grille

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Square Ceiling Diffusers (Tag-A):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Krueger.
    b. Price Industries.
    c. Titus.
    d. Or approved equal.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches.
6. Face Style: Three cone.
7. Mounting: Surface.
8. Pattern: Fixed.
9. Dampers: Radial opposed blade, operable from diffuser face.
10. Accessories:

    a. Sectorizing baffles.

B. Square Ceiling Diffusers (Tag-F):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Krueger.
    b. Price Industries.
    c. Titus.
    d. Or approved equal.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 12 by 12 inches.
6. Face Style: Three cone.
7. Mounting: Surface.
8. Pattern: Fixed.
9. Dampers: Radial opposed blade, operable from diffuser face.
10. Accessories:

    a. Sectorizing baffles.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Grille (Tag-B):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Krueger.
    b. Price Industries.
    c. Titus.
    d. Or approved equal.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Vertical spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
7. Frame: 1-1/4 inches wide.
8. Mounting: Countersunk screw.
9. Accessories:

    a. Rear-blade gang operator.

B. Fixed Face Bar Grille, (Tag-C):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Price.
    b. Titus.
    c. Krueger.
    d. Or approved equal.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw.
8. Accessories:

    a. Opposed blade damper for all concealed gypsum board installations.

C. Spiral Duct Supply Register, (Tag-E):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Price.
    b. Titus.
    c. Krueger.
    d. Or approved equal.

2. Material: Steel.
3. Finish: Baked enamel, in color chosen by the architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
7. Frame: 1-1/4 inches wide.
8. Damper: Air scoop, operable from face.
9. Mounting: Countersunk screw.

D. Heavy Duty Fixed Face Register (TAG-D)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Krueger.
    b. Price Industries.
    c. Titus.
    d. Or approved equal.

2. Material: Heavy duty extruded aluminum.
3. Finish: White powder coat.
4. Face Blade Arrangement: Horizontal spaced 1/2 inch apart. Blades are parallel to the long dimension.
5. Blade Deflection: 30 degrees.
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed blade, operable from register face.

2.3 ROUND CONE DIFFUSERS

A. Round cone diffuser (TAG-G)

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Price.
    b. Titus.
    c. Krueger.
    d. Or approved equal.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, in color chosen by architect.
5. Face Style: Three cone.
6. Mounting: exposed.
7. Pattern: Fixed.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units).

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wind-Restraint Details: Detail fabrication and attachment of wind restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Roof openings
3. Roof curbs and flashing.

B. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces of 115 MPH for Basic Wind Speed, Building Classification Category III and minimum 50 lb/sq. ft (48.8 kg/sq. m) multiplied by the maximum area of unit projected on a vertical plane that is normal to the wind direction and 45 degrees either side of normal for wind-restraint performance requirements.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control test reports.

D. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Two set of filters for each unit. (One set for installation at completion of project and one set for Owner's attic stock)

1.8 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.
3. Packaged air-cooled condenser units shall be certified in accordance with ANSI/ AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
4. Unit Energy Efficiency Ratio (EER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

G. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.

H. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard parts and associated labor, but not less than five years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard parts and associated labor, but not less than 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON.

2. Valent.

3. Daiken.

4. Or approved equal.

B. Note that Engineer will review in detail submittals for this equipment and will not approve incomplete submittals that do not clearly indicate or include in detail the items indicated to be provided in the above submittal section of this specification. Engineer will not approve submittals that do not meet or exceed all performance and construction requirements indicated in the specifications and drawings for this project. Any of the three manufacturers products noted above are to be provided by authorized manufacturer’s representative companies of the Contractor whom is submitting a proposal. Engineer will not approve submittals that do not come from the authorized manufacturer’s representative company for the Contractor whom is submitting a proposal. If authorized manufacturer’s representative company for the Contractor is different than authorized manufacturer’s representative company of the Engineer then authorized manufacturer’s representative company for the Contractor shall contact and coordinate with authorized manufacturer’s representative company of the Engineer. If contact and coordination are not performed Engineer will not approve submittals.

2.3 PACKAGED UNITS

A. General Description

1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, gas heaters, electric heaters, exhaust fans, energy recovery wheels, and unit controls.

2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report

shall be supplied with the unit in the service compartment's literature pocket.

3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

4. Unit components shall be labeled, including refrigeration system components and electrical and controls components.

5. Estimated sound power levels (dB) shall be shown on the unit schedule.

6. Installation, Operation and Maintenance manual shall be supplied within the unit.

7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

B. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.

3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

6. Access to filters, dampers, cooling coils, reheat coil, heaters, exhaust fans, energy recovery wheels, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.

7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.

9. Unit shall be provided with base discharge and return air openings or horizontal discharge and return air opening (As indicated on contract drawings). All openings through the unit shall have upturned flanges of at least 1/2 inch in height around the opening. All openings shall be in locations and orientation are shown on contract drawings. Manufactures that have different locations and orientation are responsible for all extra costs incurred as a result which will modify basis of design including but not limited to extra costs by contractor and Engineer for time to review the changes.

10. Unit shall include lifting lugs on the top of the unit.

11. Unit base pan shall be provided with 1/2-inch thick foam insulation.

12. Cabinet Surface Condensation:

    a. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
    b. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

C. Electrical

1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.

2. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

3. Unit shall be provided with a factory installed and factory wired 115V, 13 amp GFI convenience outlet disconnect switch in the unit control panel wired prior to unit mounted disconnect switch.

4. Unit shall be provided with minimum 10kA SCCR rating, or as indicated on contract documents.

D. Supply Fans

1. Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

2. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.

3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

4. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be inverter rated where noted on contract drawings.

5. Motors shall be high efficiency electrically communicated motor where noted on contract drawings.

E. Cooling Coils

1. Evaporator Coils

a. Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.

b. Coils shall be 6 row high capacity

c. Coils shall have interlaced circuitry and shall be 6 row high capacity.

d. Coils shall be helium leak tested.

e. Coils shall be furnished with factory installed thermostatic expansion valves.

F. Refrigeration System

1. Unit shall be factory charged with R-454B refrigerant.

2. Compressors shall be scroll type with thermal overload protection and independently circuited.

3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.

4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.

5. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.

6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed replaceable core liquid line filter driers.

7. Unit shall include a variable capacity scroll compressor on the refrigeration circuit which shall be capable of modulation from 10-100% of its capacity where noted on contract drawings.

8. Unit shall be two-step scroll type compressor with thermal overload protection and be independently circuited. Two-step compressors shall include 2 stages of capacity control, 65% and 100% where noted on contract drawings.

9. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity where there is more than one compressor indicated where noted on contract drawings.

10. Refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.

11. Where there are more than one refrigerant circuits, Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space where there is more than one compressor indicated.

12. Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.

13. Each refrigeration circuit shall include adjustable compressor lockouts.

H. Condensers

1. Air-Cooled Condenser

a. Condenser fans shall be a vertical discharge, axial flow, variable speed direct drive fans.

b. Coils shall be designed for use with R-454B refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes or constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design of copper tubes shall be sine wave rippled.

c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.

d. Coils shall be helium leak tested.

e. Condenser fans shall be high efficiency electrically commutated motor driven variable speed with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35 degree F with adjustable compressor lockout.

I. Gas Heating

1. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.

2. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.

3. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.

4. Natural gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. Gas heating assemblies shall be capable of operating at any firing rate between 100% and 30% of their rated capacity.

K. Filters

1. Unit shall include 2-inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8 and 4-inch thick, pleated panel filters with an ASHRAE efficiency of 85% and MERV rating of 13, upstream of the cooling coil.

2. Unit shall include 1-inch aluminum mesh pre filters upstream of the outside air opening.

3. Units shall include a Magnehelic gauge mounted in the controls compartment.

L. Outside Air/Economizer

1. Units shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return, DDC actuator. Unit shall include outside air opening bird screen and outside air hood with rain lip and barometric relief dampers.

K. Energy Recovery

1. Unit shall contain a factory mounted and tested energy recovery wheels. The energy recovery wheels shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings. Frame shall slide out for service and removal from the cabinet.

2. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt.
3. The energy recovery cassette shall be an Underwriters Laboratories Recognized Component for electrical and fire safety. The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in thecassette frame and supplied with a service connector or junction box. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangersand AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI Certified Products.
4. Energy recovery wheel cassette shall carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory. The first 12 months from the date of equipment startup, or 18 months from the date oforiginal equipment shipment from the factory, whichever is less, shall be covered under the standard AAON limited parts warranty. The remaining period of the warranty shall be covered by Airxchange. The 5 year warranty applies to allparts and components of the cassette, with the exception of the motor, which shall carry an 18 month warranty. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided the Airxchangewritten instructions for Installation, Operation, and Maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts. Refer to the Airxchange Energy Recovery Cassette Limited Warranty Certificate.
5. Unit shall include 2 inch thick, pleated panel outside air filters with an ASHRAE MERV rating of 8, upstream of the wheels.
6. Hinged service access doors shall allow access to the wheels.
7. Unit shall include energy recovery wheel defrost control which includes an adjustable temperature sensor and timer wired to periodically stop the wheel rotation, which allows the warm exhaust air to defrost the wheel.
8. Aluminum Energy Recovery Wheels:

    a. Unit shall contain a factory mounted and tested monolithic aluminum energy recovery wheel with an inverter duty motor and a steel-enforced drive belt composite. Wheel frame shall be constructed with prime G90 hot-dip galvanized steel tested for corrosion resistance of 400 hours of salt spray.
    b. Aluminum Energy recovery wheel shall be covered under the standard AAON limited parts warranty; the first 12 months from the date of equipment startup, or 18 months from the date of original equipment shipment from the factory, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided the written instructions for installation, operation and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts.
    c. Total energy recovery wheels shall be made of corrugated aluminum with a 3A molecular sieve desiccant coating. Coated segments shall be cleanable with low temperature steam, hot water, or light detergent without degrading the latent recovery.

N. Curbs

1. Materials: Galvanized steel with corrosion-protection coating, watertight and continuously gasketed, and factory-installed wood nailer; complying with NRCA standards.
2. Curbs shall be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be

mounted on the curb immediately before mounting of the rooftop unit. Sides of curbs to be lined with 1inch neoprene coated fiberglass insulation and include a wood nailer. Install RTUs on curbs and coordinate roof penetrations and flashing with existing roof construction. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3. Factory Applied Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

    a. Materials: ASTM C 1071, Type I or II.
    b. Thickness: 1 inch.

4. Samsel Upper ES: Provide RTU-2 and 4 with custom plenum adapter curb with horizontal supply and return air duct connections to connect to existing roof mounted ductwork.
5. Middle School: Curbs to be adapter type and designed to match existing supply and return openings.
6. High school, RTU-15, 16, ERU-1 and ERU-2: Curbs to be adapter type and designed to match existing supply and return openings.

2.5 CONTROLS

A. Factory Installed and Factory Provided Controller:

1. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested.
2. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
3. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
4. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a BACnet network.

B. Additional field provided and installed Control devices are specified in Section 230900 "Instrumentation and Control for HVAC."

C. Unit shall be provided with BACnet communications interface. Refer to Sequence of Operations indicated on contract documents.

D. Unit shall be provided with a safety shutdown terminal block for field installation of a smoke detector which shuts off the unit's control circuit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Connect supply and return ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

a. Measure gas pressure on manifold.
b. Inspect operation of power vents.
c. Measure combustion-air temperature at inlet to combustion chamber.
d. Measure flue-gas temperature at furnace discharge.
e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

27. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.

29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 237413

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five years from date of Substantial Completion parts and labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. LG.
2. Carrier.
3. Samsung.
4. Or approved equal.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components (Type AC):

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
5. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Grille kit: Model PC4SUFMUN.
8. Filters: Permanent, cleanable.
9. Condensate Drain Pans:

    a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face.
        2) Depth: A minimum of 2 inches deep.

    b. Single-wall, stainless-steel sheet.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

        1) Minimum Connection Size: NPS 1.

    d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

10. Condensate Pump:

    a. Unit shall have a factory installed and wired condensate drain pump capable of providing minimum 29 inch lift from bottom surface of the unit.
    b. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant Charge: R-32.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Hard wired to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).

3.2 CONNECTIONS

A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238127 – VARIABLE REFRIGERANT FLOW SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SYSTEM DESCRIPTION

A. Variable Refrigerant Flow (VRF) HVAC system shall be a variable capacity, direct expansion (DX) heat recovery and heat pump engineered system. The outdoor unit shall consist of one or more cabinet(s) connected through common refrigerant piping. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to multiple indoor units (ducted, non-ducted or combination thereof) through a common refrigerant piping and integrated system controls. Each indoor unit shall be controlled individually. Additionally heat recovery system shall be capable of simultaneous heating and cooling individual zone(s).

1. Simultaneous Cooling and Heating VRF System: Heat recovery system shall be an air cooled, system consisting of one to three outdoor unit(s) connected to Heat Recovery (HRU) unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, sequence of operations and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Organization for Standardization (ISO).

B. All electrical power wiring shall be installed in accordance with the National Electrical Code (NEC) and all applicable state and local building codes.

C. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label and comply with UL 1995 Heat and Cooling Equipment Standard for Safety.

D. All systems must be AHRI 1230 Certified and listed in the certified product directory.

E. The VRF system shall be installed by a licensed mechanical contractor trained by the VRF equipment manufacturer or certified manufacturer’s agent. If contractor is not licensed by VRF equipment manufacturer as an approved installer then contractor shall provide written proof of certification prior to the start of installation.

1.7 STORAGE AND HANDLING

A. All VRF equipment shall be stored protected from weather, extreme temperature, etc. as suggested by the manufacturer. All VRF equipment shall be moved, lifted, etc. as suggested by the manufacturer.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: Two year(s) from date of Substantial Completion.
c. For Labor: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. LG Multi-V VRF (Casey Younkins at Energy Transfer Solutions, Inc. – 610-444-0333)
   2. Or approved equal.
   3. Other comparable products by the other manufacturers listed above if submitted other than the basis of design product (LG Multi-V VRF) must meet or exceed all performance and capacity criteria of the basis of design product. This will be reviewed in detail by Engineer during the submittal process as needed.

2.2 SIMULTANEOUS HEATING AND COOLING OUTDOOR UNIT (TYPE OHRU)

B. Outdoor Unit shall be capable at the following operating ambient air conditions.
   1. Heat Recovery System:
      a. Cooling: 14 deg F dry bulb to 122 deg F dry bulb.
      b. Heating: -13 deg F wet bulb to 61 deg F wet bulb.
      c. Cooling based synchronous: 14 deg F dry bulb to 81 deg F dry bulb.
      d. Heating based synchronous: 14 deg F wet bulb to 61 deg F wet bulb.

C. General:
   1. The air-conditioning system shall use R32 refrigerant.
   2. Each system shall have one, two or three air source outdoor units.
   3. Dual and triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kit and field provided interconnecting pipe to form a common refrigerant circuit.
   4. Refrigerant circuit configuration for Heat Recovery System
      a. The refrigerant circuit shall be constructed using field provided copper piped together with manufacturer supplied Heat Recovery unit(s) and Y- branches or Header fittings connected to multiple (ducted, non-ducted or combination thereof) indoor units to effectively and efficiently control the simultaneous heating and cooling operation of the VRF system.
      b. Each refrigerant pipe, y-branch, header kit, elbows and valves shall be individually insulated with no air gaps. All joints shall be glued and sealed.
   5. Refrigerant circuit configuration for Heat Pump System
      a. The refrigerant circuit shall be constructed using field provided copper piped together with manufacturer supplied Y- branches or Headers connected to multiple (ducted, non-ducted or combination thereof) indoor units to effectively and efficiently control heating or cooling operation of the VRF system.
      b. All refrigerant pipe, y-branch, header kit, elbows and valves shall be individually insulated with no air gaps. All joints shall be glued and sealed.
   6. Factory installed microprocessor controls in the outdoor unit(s), HR unit(s), and indoor unit(s) shall perform functions to efficiently operate the VRF system and communicate in a daisy chain configuration between outdoor unit and HR unit(s) and indoor unit(s) via RS485.
   7. The system shall be designed to accept connection up to 58 indoor units.

8. The system shall be capable of performing continuous operation when an individual indoor unit is being serviced or power to indoor unit is disconnected.
9. The maximum allowable system combination ratio shall be 130%. Systems designed with combination ratio above 130% are not acceptable.
10. The total nominal capacity of all indoor units shall be no less than 50% and no more than 110% of outdoor unit's nominal capacity to ensure the VRF system will have sufficient capacity to meet the building's cooling and heating load at design day weather conditions.
11. The outdoor unit shall have a fusible plug.
12. The fusible plug shall have a threaded connector.
13. The unit shall be shipped from the factory fully assembled including internal refrigerant piping, compressor, contacts, relay(s), power and communications wiring necessary.
14. Each outdoor unit refrigeration circuit shall have the following components:
    a. Refrigerant strainer(s).
    b. Check valve(s).
    c. Oil separator.
    d. Accumulator.
    e. 4-way reversing valve.
    f. Vapor injection valve.
    g. Variable path valve.
    h. Oil Level sensor.
    i. Electronic expansion valve(s).
    j. Sub-cooler.
    k. High and low side Schrader valve service ports with caps.
    l. Service valves.

D. Refrigerant Pipe System Design Parameters:
1. The outdoor unit shall be capable of operating at an elevation difference of up to 360 feet above or below the lowest or highest indoor unit respectively.
2. The outdoor unit shall be capable of operating with up to 3280 equivalent length feet of interconnecting liquid line refrigerant pipe in the network.
3. The outdoor unit shall be capable of operating with up to 656 actual feet or 738 equivalent length feet of liquid line refrigerant pipe spanning between outdoor unit and farthest indoor unit.

E. Defrost Operations:
1. The outdoor unit(s) shall be capable of auto defrost operation to melt accumulated frost off the outdoor unit heat exchanger. The defrost cycle control shall be based on outdoor ambient temperatures and outdoor unit heat exchanger temperatures.
2. Split Coil Defrost
3. All single frame units shall have split coil defrost system
4. Split Frame Defrost
5. Multiple frame outdoor units shall be capable of split-frame defrost for 2 out of every 3 defrost cycles, allowing heating mode indoor unit fans to remain on.
6. The third defrost cycle shall switch all outdoor units to defrost mode to fully melt the ice accumulations off the outdoor coil while turning off heat mode indoor unit fans.

F. Oil Management:
1. The system shall have Hi-POR (High Pressure Oil Return) to ensure a consistent film of oil on all moving compressor parts at low speed. Oil is returned to compressor through a separate oil injection pipe.

2. The system shall be provided with a centrifugal oil separator designed to extract oil from the oil/refrigerant gas stream leaving the compressor and return the extracted oil to the compressor oil sump.
3. The system shall have an oil level sensor in the compressor to provide direct oil level sensing.
4. The system shall only initiate an oil return cycle if the oil level is too low.

G. Cabinet:
1. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with an enamel finish.
2. Outdoor unit cabinet finish shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.
3. The front panels of the outdoor units shall be removable type for access to internal components.
4. A smaller service access panel, not larger than 6.25"x 6.67" and secured by a maximum of (2) screws shall be provided to access the following:
    a. Service tool connection.
    b. DIP switches.
    c. Auto addressing.
    d. Error codes
5. The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front or through the bottom of the unit.

H. Fan:
1. Each cabinet shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.
2. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.
3. The fan(s) motor shall be equipped with permanently lubricated bearings.
4. The fan motor shall be variable speed with a maximum operating speed of 1050 RPM.
5. The fan shall have a raised guard to help prevent contact with moving parts.
6. The cabinet shall have option to change the discharge air direction from vertical to horizontal using optional factory provided air guides.
7. The cabinet shall have DIP switch setting to raise external static pressure up to 0.32 in-wg.

I. Coil:
1. The outdoor unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The copper tubes shall have inner groves.
3. The aluminum fins shall have factory applied corrosion resistant GoldFin™ material.
4. Coil coating shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours
5. The outdoor unit coil shall be tested to a pressure of 551 psig.
6. The coil for each cabinet shall have 14 Fins per Inch (FPI).
7. All the outdoor units shall have a 3 rows heat exchanger.
8. The cabinet shall have a coil guard.

J. Compressor(s):
1. Each cabinet shall be equipped with two hermetically sealed, inverter driven, digitally controlled scroll compressors.
2. Each inverter driven, digitally scroll compressor shall be capable of operating in a frequency range from 15 Hz to 150 Hz with control in 0.5 Hz increments.

3. The compressor(s) shall be equipped with a 60 Watt crankcase heater.
4. The compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
5. The compressor bearing(s) shall have Teflon™ coating.
6. The continuous operating range shall be
   a. Cooling: 14°F to 119°F (DB)
   b. Heating: 13°F to 75°F (WB)
7. The compressor(s) shall be protected with:
   a. High Pressure switch
   b. Over-current /under current protection
   c. Phase failure
   d. Phase reversal

K. Electrical:
1. The outdoor unit electrical power shall be 208V, 60 Hz, 3 phase.
2. The outdoor unit shall be capable of operation within voltage limits of +/- 10% rated voltage.
3. The outdoor unit shall be controlled by integral microprocessors.

L. Sound Levels:
1. Each cabinet shall be rated with a sound level not to exceed 59.5 dB(A) when tested in an anechoic chamber under ISO3745 standard.

M. Sensors:
1. Each single cabinet shall have:
   a. Suction temperature sensor.
   b. Discharge temperature sensor.
   c. High Pressure sensor.
   d. Low Pressure sensor.
   e. Outdoor temperature sensor.
   f. Outdoor unit heat exchanger temperature sensor.

N. Controls:

1. The control circuit between the indoor units, heat recovery box and the outdoor unit shall be 24VDC completed using a 2-conductor, stranded, and shielded cable for the RS485 daisy chain communication.

2. The system shall be furnished with a Central Controller for system management and administration with Bacnet interface for readable and writable points for integration into a future campus control system.

2.3 4-WAY CEILING CASSETTE INDOOR UNIT

A. General:
1. Unit shall be factory assembled, wired, piped and run tested.
2. Unit shall be designed to be installed for indoor application.
3. Unit shall be designed to mount recessed in the ceiling and has a surface mounted concentric grille on the bottom of the unit.

4. The unit shall be available in both 2’ x 2’ and 3’ x 3’ chassis.
5. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.

B. Casing and Panel:
1. Unit case shall be manufactured using galvanized steel plate.
2. The unit shall be provided with an off-white Acrylonitrile Butadiene Styrene (ABS) polymeric resin architectural grille.
3. The grille shall have a tapered trim edge, and a hinged, spring clip (screw-less) return air filter-grille door.
4. Unit shall be provided with metal ears designed to support the unit weight on four corners.
5. Ears shall have pre-punched holes designed to accept field supplied all thread rod hangers.

C. Cabinet Assembly:
1. Unit shall have four supply air outlets and one return air inlet.
2. The supply air outlet shall be through four-directional slot diffuser each equipped with independent oscillating motorized guide vane designed to change the airflow direction.
3. The grille shall have a discharge range of motion of 40° in an up/down direction with capabilities of locking the vanes.
4. The unit shall have a guide vane algorithm designed to sequentially change the predominant discharge airflow direction in counterclockwise pattern.
5. Guide vanes shall provide airflow in all directions.
6. Unit shall be equipped with factory installed temperature thermistors for
   a. Return air.
   b. Refrigerant entering coil.
   c. Refrigerant leaving coil.
7. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
8. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
9. The unit shall have factory designated branch duct knockouts on the unit case.
10. The unit shall have provision of fresh air ventilation through a knock-out on the cabinet.
11. The branch duct knockouts shall have the ability to duct up to one-half the unit airflow capacity.
12. The branch duct cannot be ducted to another room.
13. Unit shall have the following functions as standard
    a. Self-diagnostic function.
    b. Auto restart function.
    c. Auto changeover function (Heat Recovery system only).
    d. Auto operation function.
    e. Child lock function.
    f. Forced operation.
    g. Dual thermistor control.
    h. Sleep mode.

D. Fan and Motor Assembly:
1. The unit shall have a single direct driven turbo fan.
2. The fan shall be made of high strength ABS HT-700 polymeric resin.

3. The fan motor is Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
4. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
5. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
6. In cooling mode, the indoor fan shall have the following settings: Super Low, Low, Med, High, Power Cool and Auto.
7. In heating mode, the indoor fan shall have the following settings: Super Low, Low, Med, High and Auto.
8. The Auto fan setting shall adjust the fan speed to most effectively achieve the set-point.
9. Unit shall have factory installed motorized louver to provide flow of air in up and down direction for uniform airflow.

E. Filter:
1. The return air inlet shall have a factory supplied primary removable, washable filter.
2. The filter access shall be from the bottom of the unit.

F. Coil:
1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. Unit shall have minimum of 2 rows of coils.
3. Unit shall have a factory supplied condensate drain pan below the coil.
4. Unit shall have provision of 45° flare refrigerant pipe connections
5. The coil shall be factory pressure tested at a minimum of 551 psig.
6. All refrigerant piping from outdoor unit or Heat Recovery (HR) unit to indoor unit shall be field insulated.

G. Condensate Pump:
1. Unit shall have a factory installed and wired condensate drain pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
2. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.

H. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 Hz.
2. The indoor unit shall be capable of operation within voltage limits of +/-10% rated voltage.

I. Controls:
1. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.
2. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system in an override capability only with +/- 3 deg F from front end provided setpoint. The system shall be furnished with an AC Smart Central Controller for system management and administration with BACnet interface for readable and writable points for building control system.
3. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
4. The unit controls shall operate the indoor unit using one of the five operating modes:
   a. Auto changeover.

b. Heating.
c. Cooling.
d. Dry.
e. Fan only.

O. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).

D. Install all controls and control wiring noted above and required for a complete fully correctly functioning VRF system. This to include time required for programming of the system to provide a system manufacturer sequence of operation to be submitted and approved by Engineer.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized and factory-employed service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized and factory-employed service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Engage a factory-authorized and factory-employed service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.4 DEMONSTRATION

A. Engage a factory-authorized and factory-employed service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238127

SECTION 238239 – UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cabinet unit heaters with centrifugal fans and hot-water heating coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

   1. Plans, elevations, sections, and details.
   2. Location and size of each field connection.
   3. Details of anchorages and attachments to structure and to supported equipment.
   4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
   5. Location and arrangement of piping valves and specialties.
   6. Location and arrangement of integral controls.
   7. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For unit heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Unit Heater Filters: Furnish two spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sigma
2. Rittling
3. Vulcan
4. Or approved equal.

B. Description: A factory-assembled and -tested unit complying with ARI 440.

1. Comply with UL 2021.

C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing to prevent erosion of glass fibers.

1. Thickness: 1 inch.
2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

D. Cabinet: Steel with baked-enamel finish with manufacturer's custom paint, in color selected by Architect.

1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick, galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
3. Recessing Flanges: Steel, finished to match cabinet.
4. Control Access Door: Key operated.
5. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet, 6 inches high with leveling bolts.
6. Extended Piping Compartment: 8-inch- wide piping end pocket.
7. False Back: Minimum 0.0428-inch- thick steel, finished to match cabinet.

E. Filters: One inch throwaway.

F. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

G. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.

H. Fan and Motor Board: Removable.

1. Fan: Forward curved, high static, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

I. Control devices and operational sequences are specified in Division 23 Section "Instrumentation and Control for HVAC" and "Sequence of Operations" on plans. Refer to this section and plans for additional requirements for unit manufacturer provided controls and ATC contractor provided controls.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

E. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Comply with safety requirements in UL 1995.

E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."

F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238239

SECTION 260000 – ELECTRICAL SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

B. The requirements of all other sections of Division 26, 27 and 28 apply to this section.

1.2 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a 1-year warranty on all materials, labor and systems from the date of Substantial Completion for each Phase. The date of Substantial completion will be as set in a letter issued by the Architect.

1.3 DEFINITIONS

A. For a complete list of definitions for this contract refer to the Division 1 specifications.

B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.4 SCOPE OF WORK

A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the electrical work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:

1. General:
    a. Contractor shall provide temporary lighting and GFCI construction power.
    b. For detailed scope of work for each electrical system, refer to the respective Division 26, 27 & 28 specification sections.
    c. Provide excavation, backfill, compaction and resurfacing to match the existing surface finish (i.e. asphalt, concrete, grass, etc.) based on the existing site and as required in these specifications and shown on contract drawings.
    d. Provide and install new grounding system per 2020 NEC.
    e. Testing and balancing of Electrical system.
    f. All necessary rigging.
    g. Removal of trash and general clean-up.

h. All necessary permits, approvals, fees, etc.
i. Instructions to the Owner.
j. Cutting, patching and clean-up.
k. The contractor shall employ the services of the local Underwriters' Inspection Agency and pay for all associated fees.

2. Scope of Work:
   a. Refer to Drawing E-001 for Contractor Responsibility Chart.
   b. Provide and install electrical power and communications ductbanks with conduits as shown on site plan.
   c. Provide and install new pad mounted outdoor natural gas fired emergency generator, including pad and all conduit and wiring from the electrical room to the generator for a complete and fully functional emergency supply system.
   d. Provide and install new generator quick-connect cabinet on the building exterior.
   e. Provide and install new indoor optional standby ATS with external surge suppression.
   f. Provide and install new indoor Life Safety ATS with external surge suppression. Prior to releasing equipment, the contractor is required to provide a selectively coordinated life safety system for all applicable breakers, as noted on the drawings.
   g. Provide and install new panelboards for the emergency distribution system, including conduits, cables. All conduits and wiring for the life safety system shall be separated as per the NEC requirements.
   h. Provide and install new medium voltage pad mounted loop switch, including foundation, conduits and cabling.
   i. Provide and install new medium voltage pad mounted transformer, including foundation, conduits and cabling.
   j. Provide and install new electrical service entrance MDP, including house keeping pad, conduits and cabling.
   k. Provide and install new conduits and feeders to new electrical panels.
   l. Provide and install new power distribution and lighting appliance panelboards.
   m. Provide and install new ultra-high efficiency dry-type transformers.
   n. Provide and install new wiring devices and backboxes.
   o. Provide and install new outdoor site lighting fixtures, conduit, wiring and controls.
   p. Provide and install new handholes and underground conduits for site lighting.
   q. Provide and install new lighting fixtures, exit signs, wiring, conduit and lighting controls.
   r. Provide new digital lighting control system room controllers, with 0-10V dimming via wall stations, where indicated on plans, as well as low-voltage 0-10V and branch circuit wiring to each associated fixture. Lighting controls shall incorporate receptacle control.
   s. Provide new interior normal/emergency lighting, with fixtures wired to generator panels via UL924 relays to allow for normal lighting control and emergency operation.
   t. Provide and install new exterior building mounted lighting fixtures, conduit, wiring and controls.
   u. Provide and install conduits and backboxes for the equipment documented in the telecom infrastructure IT Plant drawings and specifications.
   v. Provide and install conduits and backboxes for the equipment documented in the security drawings and specifications.
   w. Provide and install, conduit and backboxes to all equipment documented in the AV drawings.
   x. Provide and install new initiation and notification fire alarm devices and equipment, including cabling, detectors, strobes, horn/strobes, pull stations, etc.

Remove and reinstall, or relocate devices as indicated on plans where necessary for construction activities. Entire fire alarm system shall be tested at the completion of the project per NFPA 72, to ensure all devices are fully functional. Contractor to replace all fire alarm wiring from the fire alarm control panel to new, relocated, and existing fire alarm devices within the renovation area. Shop drawings should show this new wiring, including new notification zones/circuits. The new fire alarm system shall be a networked extension of the existing JCI/Simplex fire alarm network, including any required CAT6/fiber network connections.

y. Provide and install wiring and final connections to all equipment in Architectural Specifications requiring electrical service.

z. Provide and install wiring for all mechanical, plumbing, fire protection and architectural equipment on the project. Provide and install NEC required disconnecting means for all required equipment and locations.

B. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Structural, Civil, Fire Protection, Mechanical, Plumbing and Electrical) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

C. Coordination Between Mechanical (MC), Electrical (EC) and Plumbing (PC) Contractors:

1. The Electrical Contractor shall:

a. Receive and set the motor starters as provide by the Mechanical and Plumbing Contractors.

b. Provide power wiring, including final connection of same, from source to starters or contactors to motors.

c. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.

d. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the HVAC system and as required by the National Electrical Code, or as shown on the drawings, or as specified.

e. Adjust connections to electrical motors to insure proper rotation.

f. Provide duct detectors and tubes to the MC for installation in the ductwork. EC shall wire and program the duct detectors and remote test stations into the fire alarm system. MC shall wire from the detectors into the HVAC equipment for shut-down.

g. Provide 120V to junction boxes for the MC to install 120-24V transformers. EC to receive the transformer from the MC and install & wire up the 120V side of the transformer. MC shall provide all 24V wiring.

h. Provide 120V to junction boxes for the PC provided low-voltage 120-24V transformers. EC to receive the transformer from the PC and install & wire the transformer. EC shall install conduit in walls for all 24V powered plumbing fixtures – conduits shall be routed to backbox to above the finished ceiling from back boxes for each plumbing fixture. Coordinate with PC.

2. The Mechanical Contractor will:

a. Furnish and set all motors for mechanical equipment.
b. Furnish all motor starters, starter/disconnects, HVAC unit mounted disconnects, contactors, pushbuttons and switches for local and remote control of all HVAC equipment and turn over to the Electrical Contractor for installation.
c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strips.
d. Furnish and install duct and pipe-mounted control devices, such as freezestats, aquastats, flow switches, etc.
e. Furnish wiring diagrams for the systems, in sufficient time to allow roughing-in of conduit in accordance with the proposed work schedule.
f. Provide all control wiring including 120V controls, 120V power and 120/24V control power transformers as required for a complete and fully functional HVAC DDC control system. The MC is required to provide 120V power to their HVAC DDC control panels, valves, dampers and other systems, as required.
g. Provide 120V-24V transformers to the EC for mounting and wiring.
h. Receive duct detectors from the EC and install in the ductwork. MC shall provide and install all shut-down and system activation wiring from the smoke detectors to the respective HVAC units.

3. The Plumbing Contractor will:

a. Furnish and set all motors for plumbing equipment.
b. Coordinate locations of all equipment with both the Mechanical and Electrical Contractors.
c. Provide the Electrical Contractor with information and instructions for connection of electrical service to water coolers, domestic hot water heater, etc.
d. Provide and install 120V to 24V control power transformers for the electronic sensors associated with the Water Closets, Lavatories and Urinals. PC shall provide and install all 24V wiring from the transformers to all fixtures. EC will only provide 120V connection to the transformer.

4. The Electrical Contractor shall examine the drawings and read the specifications for the mechanical trades, and shall note all motor-driven equipment, starters and control apparatus noted, shown or specified herein.

D. Architectural Equipment Wiring and Connections:

1. All equipment for will be furnished and set by the Equipment Contractor.
2. The Electrical Contractor shall run all electrical conduit and wiring to each piece of equipment requiring electrical service and shall make all final connections to the equipment.
3. The equipment and required wiring connections are shown on the drawings.
4. This Electrical Contractor shall furnish disconnect switches at the various pieces of equipment as required by the NEC.

1.5 WARRANTY

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion."

B. All equipment is to include factory start-up unless the Contractor receives written permission,

from the Owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this Project shall include a 1-year warranty on parts and labor.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION 260000

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Link Seal.
d. Metraflex Co.
e. Pipeline Seal and Insulator, Inc.
f. Or approved equal

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable

penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals. Link-Seal modular, elastomer sealing system shall be used for existing walls in underground situations with no sleeve.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping." Refer to the Architectural drawings for locations of all fire-rated floor and wall assemblies.

END OF SECTION 260500

SECTION 260513 – MEDIUM VOLTAGE CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

B. Requirements specified in all other sections of Division 26 apply to this Section.

1.1 SUMMARY

A. This section includes single conductor cables and splices, terminations, conduits, ductbanks, manholes and accessories for 15 KV electrical distribution systems.

B. Related Sections: The following Division 26 Sections contain requirements that relate to this Section:

1. "Raceways and Boxes for Electrical Systems" for conduits for cable.
2. “Underground Ducts and Raceways for Electrical Systems” for conduits, ductbanks, and manholes.

1.3 SUBMITTALS

A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections.

B. General: Submit the following:

1. Product data on cables, splices, and cable accessories including descriptions and detailed specifications.
2. Cabling pulling calculations.
3. Test Plan.
4. Cable labels and specific labeling verbiage for each label condition.
5. Report of Field Tests: Certified copies of field test records.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer of medium-voltage electrical cable to perform the installation specified in this section.

B. Electrical Component Standard: Components and installation shall comply with latest edition of the NFPA 70 "National Electrical Code."

C. IEEE Compliance: Comply with applicable IEEE standards including C2 "National Electrical Safety Code."

D. UL Compliance: Cables and components shall be listed and labeled by UL.

1.5 WARRANTY

A. The contractor shall warrant the completed medium voltage cabling to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of Substantial Completion. Refer to Division 1 specifications for definition of Substantial Completion.

B. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Engineer issues the letter of "Substantial Completion."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements provide products by the following:

1. Cable:
   a. Pirelli Cable Corp.
   b. Southwire.
   c. The Okonite Co.
   d. Or approved equal

2. Cable Splicing and Terminating Products and Accessories:
   a. Electrical Products Division 3M.
   b. G&W Electric Co.
   c. RTE Components.
   d. Joslyn Mfg. & Supply Company.
   e. Raychem
   f. Or approved equal

2.2 MEDIUM-VOLTAGE CABLE

A. General: Cable shall be single-conductor type, size as indicated, and conforming to UL Standard 1072 "Medium Voltage Power Cables."

B. Service Requirements: Subject to compliance, provide Medium Voltage cables for 5kV Service.

C. Cable shall be MV-105, 15kV single conductor Copper cable, with a 133% insulation (220 mils), copper tape shield, for a 3 wire distribution circuit. Provide Okoguard-Okoseal Type MV-105 15kV Power Cable with copper tape shield or approved equal. The cable shall have the following characteristics:

1. Conductors: Annealed uncoated copper, compact stranded per ASTM B-496
2. Strand Screen: Extruded semiconducting EPR strand screen. Shall meet or exceed the electrical and physical requirements of ICEA S-68-516, AEIC CS6 and UL 1072.
3. Insulation: Shall meet or exceed the electrical and physical requirements of ICEA S-68-516, AEIC CS6 and UL 1072.
4. Insulation Screen: Extruded semiconducting EPR insulation screen. Shall meet or

exceed the electrical and physical requirements of ICEA S-68-516, AEIC CS6 and UL 1072.
5. Tape Shield: 5 mil bare copper helically applied.
6. Cable Voltage Rating: 15 KV phase to phase.
7. Cable Jacket: Shall meet or exceed the electrical and physical requirements of ICEA S-68-516 and UL 1072 for polyvinyl chloride jackets.

2.3 MARKER

A. Cables shall be identified with manufacturers' name, conductor size, conductor material, voltage rating and insulation designation. This information shall appear on the cable covering at regular intervals. A permanent marker indicating the phase, manufacturer, year of manufacture, and sequential footage number repeated each foot shall be inserted under the copper shielding tape.

2.4 ARC PROOF TAPE

A. In all equipment, manholes and junction boxes, provide and install arc proof tape on all 15kV cabling. Provide a ½ lap joint for all arc proof taping installations.

B. In manholes, the arc proof tape shall be applied over all three conductors. In equipment, the arc proof tape shall be applied over each individual conductor.

C. Provide 2" wide tape, apply with a ½ lap joint, of 30-mil Plymouth-Bishop 53 Plyarc Arc and Fire Proofing tape or approved equal by 3M or Mac Products, Inc.

D. Glass Tape: Band the arc-proofing tape with 1-inch-wide bands of half-lapped adhesive glass-cloth tape 2" on center.

2.5 SPLICING AND TERMINATING PRODUCTS

A. General: Comply with the following standards:

1. IEEE 48: "IEEE Standard Test Procedures and Requirements For High-Voltage Alternating Current Cable Terminations."
2. IEEE 400: "Guide For Making High-Direct-Voltage Tests on Power Cable Systems in the Field."
3. IEEE 404: "Standard For Power Cable Joints."
4. IEEE 592: "Standard For Exposed Semiconducting Shields on Premolded High-Voltage Cable Joints and Separable Insulated Connectors."
5. UL 486A: "Wire Connectors and Soldering Lugs for Use with Copper Conductors."
6. UL 486B: "Wire Connectors and Soldering Lugs for Use with Aluminum Conductors."

B. Types: Compatible with the cable materials.

C. Connectors: Compression type as recommended by cable or splicing kit manufacturer for the application.

D. Conductor Terminations, General: Comply with Class 1, 2, or 3 of IEEE Standard 48. Insulation class shall be equivalent to that of the cable upon which they are installed. Terminations for shielded cables shall include a shield-grounding strap. Class 2 terminations

and nonshielded cable terminations shall include an effective moisture seal for the end of the insulation whether or not this item is included in termination kits. Seal shall be silicone rubber tape, cold shrink rubber sleeve, or heat shrink plastic sleeve as recommended by the kit manufacturer. Termination kits shall be performance tested for compliance with IEEE Standard 48.

E. Terminating Kits for MV switches, indoor transformers and loop switches: Provide heat activated sealing system polymeric cable termination rated to IEEE-48, class 1 for indoor and outdoor use. Provide Raychem HVT-153-G for indoor use and HVT-152-SG for outdoor use. Provide build-up tape as per the manufacturer's recommendation.

F. Terminating Kits for outdoor pad mounted transformers and multipoint junctions: Elastimold 200A load-break elbow terminations with test points.

G. Insulation Thickness: Corresponding to 133 percent insulation level in accordance with the referenced standard.

H. The ground connections shall be made with a minimum of #2 AWG copper conductor with 600V THHN/THWN insulation.

I. Circuit Identification: Color-coded tape (black, red, blue) under the metallic shielding.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine before pulling cable, raceways, pull boxes, manholes, and other cable installation locations for cleanliness of raceways, minimum bending radii of cables, and conditions affecting performance of cable. Pull a mandrel through raceways to check for suitable conditions. Do not proceed with cable installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Install cable accessory items in accordance with manufacturer's written instructions and as indicated.

3.3 INSTALLATION OF CABLES

A. In manholes, handholes, pull boxes, junction boxes and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequately to prevent sag.

B. Pull conductors simultaneously where more than one cable is indicated in same raceway. Use UL-listed and manufacturer-approved pulling compound or lubricant where necessary. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips that will not damage cables or raceways. Do not use rope hitches for pulling attachment to cable.

D. Contractor shall provide cable manufacturer cable installation calculation submittal which shall include all pertinent data, static/dynamic friction coefficient, jam ratio, percent fill, weight,

maximum pulling tension, etc.

3.4 INSTALLATION OF SPLICES

A. Install splices at pull points and elsewhere as required using standard kit. Conform to kit manufacturer's written instructions.

3.5 INSTALLATION OF TERMINATIONS

A. Install terminations at ends of conductors and seal conductor cable ends with standard kits. Conform to manufacturer's written instructions. Comply with classes of terminations indicated.

B. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.6 INSTALLATION OF CABLE ACCESSORIES

A. Arc-Proofing: Arc-proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials, such as manholes, switchgear compartments, manholes, junction boxes and the like. Apply as recommended by the manufacturer of the arc-proofing tape and the following:

1. Clean cable sheath.
2. Wrap metallic cable components with 30-mil wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with the coated side toward the cable.
5. Band the arc-proofing tape with 1-inch-wide bands of half-lapped adhesive glass-cloth tape 2" on center.

3.7 TESTING

A. General: Comply with applicable standards of The InterNational Electrical Testing Association (INETA) including Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. Preparation: Perform the following preparations in advance of new cable independent tests:

1. Test cables' insulation resistance.
2. Test circuits' continuity.
3. Furnish a set of Contract Documents and manufacturer's recommendations to test organization.
4. Make power available at test locations.

C. Schedule tests and notify Engineer at least one week in advance of schedule for test commencement.

D. Test procedure shall conform to the following:

1. Independent Testing Organization: Arrange and pay for the services of an independent

electrical testing organization in accordance with the requirements of Division 1 Section "Quality Control Services" to perform tests on medium-voltage cable.

2. Test Objectives: To assure cable installation is operational within industry and manufacturer's tolerances, is installed in accordance with Contract Documents, and is suitable for energizing.
3. Procedures: Comply with the INETA standard and IEEE 400. Upon satisfactory completion of tests, attach a label to tested components.

E. Tests shall include high-potential test of cable and accessories and such tests and examinations required to achieve specified objectives. Do not hi-pot test cables over 55 VDC with termination elbows connected.

F. The tests for the cables shall include the following:

1. High-potential test the new cables prior to termination. Test new cable prior to splicing.
2. High-potential test the new cables complete after terminations are installed and connected.

G. Reports: The testing organization shall maintain a written record of observations and tests, report defective materials and workmanship, and retest corrected defective items. Testing organization shall submit written reports to the Engineer and Contractor.

3.8 GROUNDING

A. Ground shields of shielded cable and concentric neutrals at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated connector fittings, and hardware in accordance with manufacturer's written instructions.

3.9 IDENTIFICATION

A. Identify exposed conduits for 15KV cables and identify 15kV cables in all equipment and manholes and junction boxes.

1. Paint all indoor conduits containing 15kV cabling red and label as “Danger High Voltage” in white letters. Labels shall occur at least in each room/space, before/after bends and approximately every 50’ along long runs of straight conduit.
2. Label all 15kV cabling in equipment, junction boxes, manholes and the like. Labels shall be as approved by the Owner and shall at minimum contain the following information:
   a. Cable designation (i.e. Feeder #1)
   b. Project Number.
   c. Notice to Proceed date.
   d. Date of cable installation.
   e. Cable information including, but not limited to, 133% insulation, KCM sizing, number of conductors, tape shield, etc.
   f. To/From information.
   g. Other information as required by the Owner.

B. Refer also to Section “Electrical Identification for Electrical Systems.”

END OF SECTION 260513

SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

B. Refer to Section 3.2 for allowable conduit and MC cable locations.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.
5. Or approved equal

B. Copper Conductors: Comply with NEMA WC 70. All conductors on the project shall be copper, unless specifically noted as aluminum on the drawings.

C. Aluminum Conductors (only where specifically noted and allowed as shown on the drawings): Aluminum, complying with ASTM B 800 and ASTM B 801.

D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN. Conductor sizes #12 and #10 shall be solid and #8 and larger shall be stranded.

E. Type MC Cable: Aluminum armor with copper conductors. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.
6. Or approved equal

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.
5. Or approved equal

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Underground Feeders: Type XHHW, single conductors in Type PVC schedule 40 UL listed conduit. Refer to drawings for ductbanks requiring encasement in 3" of concrete.

C. Feeders Concealed in Ceilings, Walls, Partitions: Type THHN-THWN, single conductors in raceway.

D. Use the following wiring methods as indicated for all branch circuits:
   1. Outdoor, underground: Type PVC schedule 40 UL listed conduit. Refer to drawings for ductbanks requiring encasement in 3" of concrete.
   2. Indoor, Type THHN-THWN, single conductors in raceway:
      a. Mechanical rooms.
      b. Electrical rooms.
      c. Sprinkler rooms.
      d. Elevator machine rooms.
      e. Above hard / drywall ceilings.
      f. Gymnasium.
      g. Rooms with exposed ceiling structure.
      h. In concrete block walls.

   3. In areas listed above in D2, MC cable jumpers to equipment are acceptable. Maximum MC cable jumper lengths to equipment shall be 6'. Type MC aluminum-clad multi-conductor copper cabling with ground.
   4. Indoor, concealed in drywall walls and accessible ceilings and not in areas listed above in D.2: Type MC aluminum-clad multi-conductor copper cabling with ground.

E. Dimming Lighting Branch Circuits: Where branch circuit wiring is routed to 0-10V dimming light fixtures and switches, UL listed metalclad type MC-PCS (Luminary) cable. Where required to be in raceway as per D.2 above, in addition to the phase, neutral and ground wires, provide additional 2#16 AWG solid TFN Twisted jacketed pair (purple/gray) rated at 600V for 0-10V controls.

F. Class 1 Control Circuits: Type MC Cable.

G. Class 2 Control Circuits: Type MC Cable.

H. Fire Alarm: Type MC FPLP cabling where concealed in walls, cable tray, accessible ceilings, and drywall partitions and Type THHN-THWN (and/or shielded cable), in raceway as outlined in D.2 above.

I. INSTALLATION OF CONDUCTORS AND CABLES

J. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

K. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

L. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

M. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

N. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

O. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

P. Common neutrals shall not be used. Provide individual, dedicated neutral for each circuit.

Q. Common grounds are acceptable, in accordance with the NEC.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.

    a. Megger testing for 600V feeder conductors.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning cabling and retest as specified above.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
   1. Underground distribution grounding.
   2. Building grounding.
   3. IT grounding.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
   1. Ground rods.
   2. Ground rings.
   3. Grounding arrangements and connections for separately derived systems.
   4. Grounding for sensitive electronic equipment.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

   1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems and telecommunication systems based on NETA MTS.

      a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
      b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Stranded Conductors: ASTM B 8.
2. Bonding Conductor: Minimum No. 4 AWG, stranded conductor or as noted on the drawings.
3. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Exposed Cables and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Compression Connectors for all Concealed and Underground Cables: Compression kits of types recommended by kit manufacturer for materials being joined and installation conditions. Must comply with IEEE std 837-2002, UL 467 Listed and CSA 22.2 Certified or approved equal by the Engineer.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m in diameter).
   1. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum.

   1. Bury at least 30 inches (600 mm) below grade.
   2. Duct-Bank Grounding Conductor: Bury 6 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Conductor Terminations and Connections:

   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Compression connectors.
   3. Connections to Ground Rods at Test Wells: Compression connectors.
   4. Connections to Structural Steel and Poles: Compression connectors.
   5. Connections to Structural Rebar: Compression connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.
   8. Cable tray systems.
   9. All IT communications racks.
   10. New building footer rebar.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 12 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

B. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

4. Panel testing: Perform ground resistance testing between all existing and new panel boards and the main switchboard in the main electrical rooms. Provide test report indicating the resistance for each panel to the main.

C. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity 500 kVA and More: 5 ohms.
3. Structural Steel / Lightning Protection Grounds: 10 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit (galvanized).

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.
h. Or approved equal

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Galvanized Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
      5) Or approved equal

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
      6) Or approved equal

3. Concrete Inserts: Stainless Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway (including trapeze type systems): Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter. Exception:
   1. Where attached to wood framing systems in the building, the support spacing shall be double the requirements scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70.
   2. The intent of this exception is to distribute the loading of the raceways on the wood framing system.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with galvanized steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, floor boxes, handholes, overfloor raceway and cabinets for electrical wiring.

B. Refer to Section “Low-Voltage Electrical Power Conductors and Cables” for allowable applications of conduit/raceway vs. MC Cable.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FMC: Flexible metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. LFNC: Liquidtight flexible nonmetallic conduit.

F. RMC or GRS: Galvanized rigid metal conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

    a. Duct entry provisions, including locations and duct sizes.
    b. Frame and cover design.
    c. Grounding details.
    d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
    e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Maverick Tube Corporation.
5. O-Z Gedney; a unit of General Signal.
6. Wheatland Tube Company.
7. Or approved equal.

B. Rigid Steel Conduit: ANSI C80.1 with threaded fittings.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3, with compression fittings.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Fittings for EMT: Die-cast, compression type.
2. Fittings for RGS: Threaded type.

G. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. CANTEX Inc.
3. CertainTeed Corp.; Pipe & Plastics Group.
4. Condux International, Inc.
5. ElecSYS, Inc.
6. Electri-Flex Co.
7. Lamson & Sessions; Carlon Electrical Products.
8. Manhattan/CDT/Cole-Flex.
9. RACO; a Hubbell Company.
10. Thomas & Betts Corporation.
11. Or approved equal

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type PVC Schedule 40, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Spring City Electrical Manufacturing Company.
9. Thomas & Betts Corporation.
10. Or approved equal.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with the latest revision / edition of ANSI/SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC" or “COMMUNICATIONS”.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 12 inches long and larger shall have inserts for cable racks and pulling-in irons installed.
8. Listings: UL listed.
9. Ratings: ANSI/SCTE 77 Tier 22.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation.
d. NewBasis.
e. Quazite (Basis of Design)
f. Or approved equal

2.5 FLOOR BOXES

A. Manufacturers:

1. Hubbell Wiring Devices
2. Legrand Wiremold
3. Or approved equal.

B. Floor Boxes
   1. Refer to the contract drawings for selected floor box types and sizes.
   2. For each floor box, the contractor is required to coordinate:
      a. The floor slab thickness.
      b. Floor material type, so the proper floor box cover can be ordered.
      c. Devices in each box.
      d. Faceplates for each device type.
      e. Furniture feed coordination.
      f. Coordinate with Owner's A/V vendor.
      g. Dividers as required to separate 600V and low-voltage wiring.

2.6 AV BACKBOXES

A. Refer to the drawing symbol list for specific backbox requirements for AV equipment.

2.7 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoor: Apply raceway products as specified below, unless otherwise indicated:

   1. Exposed Conduit: Rigid steel conduit.
   2. Concealed Conduit, Aboveground: Rigid steel conduit.
   3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased ductbank as indicated on the drawings.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.
   6. Application of Handholes and Boxes for Underground Wiring:

a. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Deliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 22 structural load rating.
b. Route conductors and cables around (service loop) the handhole prior to exiting.

B. Indoor: Comply with the following indoor applications, unless otherwise indicated; refer also to Section "Low-Voltage Electrical Power Conductors and Cables":
1. For allowable indoor raceways and MC Cable, refer to Section 260519.
2. Indoor conduit, unless otherwise noted below: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Damp or Wet Locations or in Kitchens: Rigid steel conduit.
5. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

2. Electrical Metallic Tubing: Use die-cast compression fittings.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

K. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic, as follows:
1. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

M. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving", except provide a minimum of 3" of silt stone surrounding conduit prior to backfill, except where indicated to be concrete encased.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Tape: Bury detectable warning tape approximately 12 inches (300 mm) above direct-buried conduits.

7. For all underground conduits entering the building, provide Raychem Rayflate kits for the conduit interiors (on both ends of the conduit) to prevent water ingress to the building.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this Section:

1. "Basic Electrical Requirements."
2. "Basic Electrical Materials and Methods."

1.2 SUMMARY

A. This section includes underground electrical work including the following:

1. PVC ducts.
2. Steel ducts.
3. Duct banks.
4. Manholes.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 31 Section "Earth Moving" for general requirements for excavation, backfill and related items for ducts and manholes.
2. Division 03 Section "Cast-in-Place Concrete" for cast-in-place concrete requirements.

1.3 DEFINITIONS

A. Duct: The general term for electrical conduit and other raceway, either metallic or nonmetallic, specified for use underground, embedded in earth or concrete.

B. Duct Bank: A group of two or more ducts in a continuous run between two points.

C. Manhole: A below-the-surface enclosure or chamber, large enough for a person to enter, connecting with ducts, and affording facilities for installing, operating, and maintaining equipment or wiring.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. The shop drawing for manholes and ductbank housing the incoming service from the Utility Co. shall be approved by the Utility Co. prior to manufacturing and installation of the above.

C. Product data for metal accessories for manholes and raceway, duct, duct bank materials, and miscellaneous components. Include:

1. Frames and covers.
2. Pulling eye assemblies.
3. Pulling and lifting hardware.
4. Bolting inserts.
5. Cable stanchions, arms, and insulators.
6. Sump frames and cover.
7. Raceways and fittings.
8. Raceway supports.

D. Shop Drawings: Detail drawings and design calculations for precast manholes including reinforcing steel. Drawings shall bear the stamp of a registered professional structural engineer in the State of New Jersey.

E. Coordination drawings showing duct profiles and coordination with other utilities and underground structures.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturers of precast manholes shall be firms regularly engaged in manufacturing factory-fabricated manholes, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 SEQUENCING AND SCHEDULING

A. Coordination of the Work: Coordinate layout and installation of manholes with final arrangement of ducts as influenced by actual final location of other utilities in the field. Coordinate elevations of duct and raceway entrances into manholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and assure duct runs drain to manholes and as approved by the Architect.

1.8 EXTRA MATERIALS

A. Furnish the following extra materials matching products installed, packaged with protective covering for storage and with identification labels clearly describing contents.

1. Cable stanchions, support arms, insulators, and associated fasteners in the quantity of 10 percent of those installed for actual use in this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Precast Manholes:

a. AC Miller Co.
b. Christy Concrete Products, Inc.
c. Elmhurst-Chicago Stone Co.
d. Rotondo/Penn-Cast, Inc.
e. Smith-Midland Corp.
f. Utility Vault Co.
g. Wausau Concrete Co.
h. Or approved equal

2. Frames and Covers:

a. East Jordan Iron Works, Inc.
b. Campbell Foundry Co.
c. McKinley Iron Works.
d. Neenah Foundry Co.
e. Or approved equal

3. Nonmetallic Ducts:

a. Anamet, Inc.
b. Arnco Corp.
c. Breeze-Illinois, Inc.
d. Carlon.
e. Certainteed Products Corp.
f. Cole-Flex Corp.
g. Condux International.
h. Electri-Flex Co.
i. R&G Sloan Mfg. Co., Inc.
j. Spiraduct, Inc.
k. Or approved equal

2.2 DETECTABLE TAPE

A. Provide detectable tape above all underground duct runs for future verification of duct and cable locations. Submit cuts to the Engineer for approval.

2.3 DUCTS AND FITTINGS

A. General: Ducts and duct fittings and accessories for which listing has been obtained by one or more manufacturers shall be UL listed and labeled.

B. General: Ducts and duct fittings and accessories for which listing has been obtained by one or more manufacturers shall be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL). The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

C. Galvanized Rigid Steel Conduit: ANSI C80.1.

D. PVC Externally Coated Rigid Steel Conduit and Fittings: ANSI C80.1 and NEMA RN 1.

E. Rigid Nonmetallic Conduit (RNC): NEMA TC 1 and UL 651, Schedule 40 or 80, PVC, rated for use with 90 deg C conductors under all installation conditions.

F. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit type and material.

G. PVC and ABS Plastic Utilities Duct: NEMA TC 6, Type EB for encased burial in concrete, Type DB for direct burial.

H. Extra Strength PVC Plastic Utilities Duct: NEMA TC 8, Type EB for concrete encasement, Type DB for direct burial.

I. PVC and ABS Plastic Utilities Duct Fittings: NEMA TC 9; match to duct type and material.

J. Manufactured Bends: Not less than 36-inch radius.

2.4 CAST-IN-PLACE CONCRETE

A. Conform to Division 03 Section "Cast-in-Place Concrete" for concrete and reinforcing.

B. Aggregate For Duct Encasement: 3/8-inch maximum size.

C. Strength: 3000 psi minimum 28-day compressive strength, unless otherwise noted higher on the drawings.

2.5 PRECAST MANHOLES

A. Work Included

1. The work under this Section shall consist of the purchase and installation of precast manholes shown on the contract drawings.
2. Provide all labor, materials, equipment and services necessary to perform the work of this Section.

B. The pre-cast manholes shall be A.C. Miller or approved equal. The manholes shall be designed for an AASHTO HS20 Live Load and appropriate dead load. Portland cement shall conform to ASTM C-150, Type 1. The minimum strength required in 5000 psi aggregates shall conform as outlined to ASTM A-615 Grade 60. All wire welded fabric shall conform to ASTM A185. The uniformly sized and graded aggregates, cement, water and admixtures shall be accurately proportioned and thoroughly mixed to produce a concrete mixture of such quality so that the manhole shall conform to the test and design requirements. Knockout panels of suitable dimensions shall be provided in the manhole walls where duct lines enter the manholes as shown on the plans. Floors shall be sloped for drainage towards the sump recess. Pulling irons shall be provided in the manhole wall opposite each wall opening on the center line of the opening, a minimum of six inches (6") above the floor.

C. The manufacturer shall submit for approval showing details of construction of the Pre-Cast Manhole, including amount and placement of the reinforcing steel. Accurate records of the compression tests and core samples shall be maintained by the manufacturer and shall be made

available to the Engineer. If the Contractor desires to substitute a specific manufacturer's manhole other than specified herein, he shall submit complete information concerning the proposed substitution. No substitutions shall be made without the approval of the Engineer.

D. Manhole Frames and Covers: Provide standard type frames and covers unless noted otherwise. Provide ELECTRIC emblem for covers, unless otherwise required by the utility.

E. Waterproofing shall be submitted for approval.

2.6 RACEWAY/DUCT SEALING COMPOUND

A. Compound: Nonhardening, putty-like consistency workable at temperatures as low as 35 deg F. Compound shall not slump at a temperature of 300 deg F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and the common metals. Compound shall have no injurious effect on worker's hands or materials.

2.7 MANHOLES - MISCELLANEOUS

A. The Contractor shall provide an excavation of suitable dimensions to set the manhole. The floor of the excavation shall be level and shall have a three inch (3") sand bed to receive the manhole.

B. The Contractor shall set the frame and cover at the proper elevation. The Contractor shall provide a twelve inch (12") high ring/chimney or as shown on the plans. The Contractor will be responsible to make proper duct connections.

C. New manholes: 3/4" diameter x 10 foot ground rod shall be provided for future connection for cable shields. Contractor shall allow sufficient slack in cable shield for future connection to this ground rod.

D. Cable in the manholes shall be supported by rack type supports. The supports shall consist of a hot-dip galvanized steel tee carrying one or more hot-dipped galvanized malleable iron cable arms, for a number of cables as required, with white glaze porcelain insulators for the support of cables. Cable rack hooks shall have a stop to keep the insulators from sliding off. The racks shall be arranged for vertical mounting and shall be securely bolted in place with 5/8 inch x 4-1/2 inch hex head galvanized bolts secured with "cinch" anchors. The rack supports shall be used to support horizontal runs only. The maximum spacing shall be thirty inches.

2.8 DUCT BANK ACCESSORIES

A. Duct Supports: Rigid PVC spacers selected to provide minimum duct spacings and concrete cover depths indicated, while rigidly supporting ducts during concreting.

2.9 MANHOLE HARDWARE AND ACCESSORIES

A. Frames and Covers: Cast iron conforming to ANSI C2, "National Electrical Safety Code," Rule 323. Furnish with cast-in legend, "Electric" or "Signal" as appropriate. Cover-to-frame bearing surfaces machined.

B. Sump Frame and Grate: Comply with FS RR-F-621, Type VII for frame, Type I for cover.

C. Pulling Eyes in Walls: Eyebolt with rebar fastening insert. 2-inch diameter eye, 1-inch- by 4-

inch-long bolt. Working load embedded in 6-inch, 4000 psi concrete: 13,000 pounds minimum tension.

D. Pulling and Lifting Irons in Floor: 7/8-inch-diameter hot-dipped galvanized, bent steel rod, stress relieved after forming, and fastened to reinforced rod. Exposed triangular shaped opening. Ultimate yield strength, 40,000 pounds shear, 60,000 pounds tension.

E. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemical resistant, nonconductive thermoplastic material. 1/2-inch internal diameter by 2-3/4 inches deep, flared to 1-1/4-inch minimum at base. Tested ultimate pull-out strength: 12,000 pounds, minimum.

F. Expansion Anchors for Installation After Concrete is Cast: Zinc-plated carbon steel wedge type with stainless steel expander clip 1/2-inch bolt size, 5,300-pound rated pull-out strength, and 6,800-pound rated shear strength, minimum.

G. Cable Stanchions: Hot-rolled, hot-dipped galvanized "T" section steel, 2-1/4-inch size, punched with 14 holes on 1-1/2-inch centers for cable arm attachment.

H. Cable Arms: 3/16-gage hot-rolled, hot-dipped galvanized sheet steel pressed to channel shape, approximately two 12 inches wide by 14 inches long and arranged for secure mounting in horizontal position at any position on cable stanchions.

I. Cable Support Insulators: High glaze, wet process porcelain arranged for mounting on cable arms.

J. Ground Rods: Solid copper clad steel, 3/4-inch diameter by 10-ft. length. Provide one in each manhole and bond all metal in the manhole to the ground rod.

K. Ground Wire: Stranded bare copper, No. 4 AWG, minimum.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. General: Install ducts for wiring runs indicated. Provide sizes as indicated.

B. Single and Multiple Duct Runs for 15kV cabling: PVC schedule 40 conduit, encased in a minimum of 3” of concrete on all sides, with a #4/0 grounding conductor run within 2” of the top of the ductbank.

3.2 EXCAVATION AND BACKFILL

A. Excavation and Backfill: Conform to Division 31 Section "Earth Moving," except heavy-duty, hydraulic-operated compaction equipment shall not be used and trenching for ducts shall conform to the following:

1. Excavation: Cut trenches neatly and uniformly, and slope uniformly to required pitch.
2. For direct-buried, non-encased ducts prepare trench bottoms free from stones, soft spots, and sharp objects. Where necessary, add a 3-inch layer of stone-free sand or earth to trench bottom and compact to density of adjacent undisturbed soil to provide suitable bearing for ducts. Backfill over and around ducts on bottom of trench with stone-free

sand or earth to 6 inches minimum above tops of ducts and compact by hand or pneumatic tamper to density of adjacent undisturbed earth.

3. For each additional layer of direct-buried ducts above bottom ducts, backfill over and around each layer of ducts with stone-free sand or earth to 6 inches minimum above tops of ducts and compact by hand or pneumatically to density of adjacent undisturbed earth.
4. Separation Between Direct-Buried, Non-encased Ducts: Three inches minimum for like services, and 12 inches minimum between power and signal ducts.

3.3 INSTALLATION OF DUCTS

A. Slope: Pitch ducts to drain towards manholes and away from buildings and equipment. Minimum slope shall be 4 inches in 100 ft. Where necessary to achieve this between manholes, slope ducts from a high point in the run to drain in both directions. Drive stakes in the bottom of the trench at 6 ft. intervals maximum, and use to establish slope.

B. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. For all other curves and bends, except as otherwise indicated, use manufactured long sweep bends with a minimum radius of 25 ft. in both horizontal and vertical directions.

C. Joints in ducts and fittings shall be made up watertight in accordance with manufacturer's instructions. Couplings shall be staggered so those of adjacent ducts do not lie in the same plane.

D. Duct Entrances to Manholes: End bells spaced approximately 10 inches center to center for 5-inch ducts and varied proportionately for other duct sizes. The change from regular spacing to end bell spacing shall start 10 ft. from the end bell and shall be made without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances.

E. Duct Entrances to Buildings: PVC conduit. Install in accordance with the following:

1. Concrete-Encased Ducts: Install reinforcing in duct banks through disturbed earth near buildings and excavations and coordinate duct bank with structural design at wall so duct bank is supported at wall without reducing structural or watertight integrity.
2. Refer to Section 260533 for Link-Seal type conduit seals for each conduit entrance to the building.
3. Provide Raychem Rayflate kits for each conduit entry to the building for sealing.

F. Concrete-Encased Nonmetallic Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install in accordance with the following:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to the earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel in such a way as to form conductive or magnetic loops around ducts or duct groups.
2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. Where more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into the concrete on each side of the joint near the corners of the envelope.
3. Reinforcing: Reinforced duct banks where they cross disturbed earth and where indicated. Size and arrangement of reinforcing steel as indicated.

4. Forms: The walls of the trench may be used to form the side walls of the duct bank provided the soil is self-supporting and concrete envelope can be poured without soil inclusions. Use forms where the soil is not self-supporting.
5. Minimum Clearances Between Ducts: Three inches between ducts and exterior envelope wall, 3 inches between ducts for like services, and 12 inches between power and signal/communication ducts.
6. Depth: Except as otherwise indicated, top of duct bank shall be 24 inches below finished grade, minimum, in nontraffic areas, and 30 inches below finished grade, minimum, in vehicular traffic areas.

G. Stub-ups: Duct stub-ups to equipment shall be galvanized rigid steel. For equipment mounted on outdoor concrete pads, steel conduit shall extend a minimum of 5 ft. away from edge of pad. Install insulated grounding bushings on the terminations. The steel conduits shall be coupled to the ducts with adapters designed for the purpose and the whole encased with 3 inches of concrete.

H. Sealing: For ducts to be wired in this project, provide temporary closure at terminations. For spare ducts, seal bore of ducts at terminations. Use sealing compound and plugs as required to withstand 15 psi minimum hydrostatic pressure.

I. Pulling Cord: Install heavy-duty nylon pulling cord in ducts including spares.

3.4 INSTALLATION OF MANHOLES, GENERAL

A. General: Provide manholes of sizes, shapes, and locations as indicated. Determine final grading of ducts as influenced by possible adjustments in other utilities and surface features and discovery of underground obstructions before installing manholes. Obtain Architect's approval for manhole installation adjustments necessitated by the above. Install units plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.

B. Elevation: Install manholes with roof top 15 inches below finished grade, minimum.

C. Drainage: Install drains in bottom of units where indicated. Arrange to coordinate with drainage provisions indicated or specified.

D. Access: Install access to manhole through cast-iron frame and cover. For manholes, use 30-inch cover except as indicated. Install brick chimney to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting of cast iron frame to chimney. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.

E. Hardware: Install removable hardware including pulling eyes, cable stanchions, cable arms, and insulators as required for installation and support of cable and conductors and as indicated.

F. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of 2 anchors for each cable stanchion.

G. Grounding: Install ¾” x 10’ copper ground rod through floor of each manhole with top protruding 4 inches above floor. Seal the floor opening against water penetration with waterproof nonshrink grout. Ground exposed metal components and hardware with bare copper ground conductor. Train conductors neatly around corners. Install on walls and roof using cable clamps secured with expansion anchors.

3.5 INSTALLATION OF PRECAST MANHOLES

A. Install in accordance with ASTM C 891, "Practice for Installation of Underground Precast Concrete Utility Structures," and manufacturer's instructions.

B. Support units on a level bed of crushed stone or gravel, graded from the 1-inch sieve to the No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3.6 FIELD TESTING

A. Grounding: Test manhole grounding provisions to ensure electrical continuity of bonding and grounding connections. Make ground- resistance test at each ground rod and submit a report of the results. Use an instrument specifically designed for ground-resistance measurements.

B. Duct Integrity: Rod ducts with a mandrell 1/4-inch smaller in diameter than internal diameter of ducts. Where rodding indicates obstructions in ducts, remove the obstructions and retest.

C. Water Tightness: Make internal inspection of manholes three months after completion of construction for indications of water ingress. Where leakage is noted, remove any water found and seal leakage sources. Reinspect after two months and reseal any remaining leakage sources. Repeat process at two month intervals until leakage is corrected.

3.7 CLEANING AND RESTORATION.

A. Clean Ducts: Clean full length of ducts with a round bristle brush with a diameter 1/2 inch greater than internal diameter of duct.

B. Clean Manholes: Clean all internal surfaces of manholes including sump. Remove all foreign material.

C. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Restore disturbed paving as indicated.

END OF SECTION 260543

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.
8. Self-adhesive labels for all switches and receptacles.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation

and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.
2. Emergency Circuits: Black letters on a red field.
3. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core (detectable).
4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:
1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

E. Multiple Services: Label multiple services in the same building indicating the location of the other service and the purpose of the service.

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength: 50 lb (22.6 kg), minimum.
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands or snap-around, color-coding bands:

1. Fire Alarm System: Red.
2. Fire-Suppression Supervisory and Control System: Red and yellow.
3. Combined Fire Alarm and Security System: Red and blue.
4. Security System: Blue and yellow.
5. Mechanical and Electrical Supervisory System: Green and blue.
6. Telecommunication System: Green and yellow.
7. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and aluminum wraparound marker labels. Identify source and circuit number of each set of conductors. For all conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. For all conditions (more than one conductor in a box), identify each ungrounded conductor according to source and circuit number.

E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

I. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures, including panel source and circuit number.
b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards, including panel source and circuit number.
d. Transformers, including panel source and circuit number.
e. Electrical substations.
f. Emergency system boxes and enclosures.
g. Motor-control centers.
h. Disconnect switches, including panel source and circuit number.
i. Enclosed circuit breakers, including panel source and circuit number.
j. Motor starters and drives, including panel source and circuit number.
k. Push-button stations.
l. Power transfer equipment.
m. Contactors.

n. Remote-controlled switches, dimmer modules, and control devices, including panel source and circuit number.
o. Battery inverter units.
p. Battery racks.
q. Power-generating units.
r. Voice and data cable terminal equipment.
s. Master clock and program equipment.
t. Intercommunication and call system master and staff stations.
u. Television/audio components, racks, and controls.
v. Fire-alarm control panel and annunciators, including panel source and circuit number
w. Fire alarm initiation and notification devices shall have a clear, self-adhesive label applied that contains minimum 10 pt black lettering indicating the SLC or NAC panel loop number and address or number of the device.
x. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
y. CCTV systems.
z. Monitoring and control equipment.
aa. Uninterruptible power supply equipment.
bb. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
cc. Junction boxes with panel source and circuit number(s).
dd. Receptacles and switches, including panel source and circuit number. Minimum 10 pt font. See 3.2.K below for additional requirements.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

2. Colors for 208/120-V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.

3. Colors for 480/277-V Circuits:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

J. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

K. For all Receptacles and switches, provide the following labeling: Provide clear, self adhesive label on all faceplates with 10 pt black lettering identifying the panel source and circuit number.

L. For all architectural/food service, mechanical, plumbing and fire protection equipment, provide the following labeling:
    1. Indoor: Provide clear, self adhesive label with minimum 10 pt black lettering identifying the panel source and circuit number.
    2. Outdoor: Provide engraved label with minimum 14 pt black lettering identifying the panel source and circuit number.

END OF SECTION 260553

SECTION 260573 – OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This coordination studies, and the setting of these devices.

1. Coordination Section includes computer-based, fault-current and overcurrent protective device of series-rated devices is permitted where indicated on Drawings.

2. Coordination and Arc Flash analysis shall include the entire existing electrical distribution system down to the branch panel level.

3. Arc Flash analysis and arc flash labeling of equipment.

4. The contractor is responsible to provide all existing equipment nameplates, ratings, types, feeder sizes, feeder lengths, etc. to the engineer performing this study.

5. The contractor is responsible to contact the utility to obtain the available fault current (3-phase and single line to ground) at the electrical service point.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals:

1. Coordination-study input data, including completed computer program input data sheets.
2. Coordination-study report.
3. Equipment evaluation report.
4. Setting report.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

C. Testing Agency Qualifications: Member company of the InterNational Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise testing specified in Part 3.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by one of the following:

1. SKM Systems Analysis, Inc. (Basis of Design).
2. Or approved equal.

B. A USB drive with an electronic version of the files provided in the study shall be included in the submittal.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399, Table 7-4.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.

3.2 FAULT-CURRENT STUDY

A. Source Impedance: Utility company's fault-current contribution as indicated by the Utility. Contractor is responsible to acquire necessary Utility information to complete the study.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:

1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50.
2. Low-Voltage Fuses: IEEE C37.46.
3. Circuit Breakers: IEEE C37.13.

E. Study Report: Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault-current values for 3-phase, 2-phase, and phase-to-ground faults.

F. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing fault-current ratings of these devices with calculated fault-current momentary and interrupting duties.

3.3 COORDINATION STUDY

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical distribution system diagram showing the following:

    a. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment.

b. Circuit-breaker and fuse-current ratings and types.
c. Relays and associated power and current transformer ratings and ratios.
d. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
e. Generator kilovolt amperes, size, voltage, and source impedance.
f. Cables. Indicate conduit material, sizes of conductors, conductor insulation, and length.
g. Busway ampacity and impedance.
h. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.
b. Magnetic inrush current overload capabilities of transformers.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. Ratings, types, and settings of utility company's overcurrent protective devices.
e. Special overcurrent protective device settings or types stipulated by utility company.
f. Time-current-characteristic curves of devices indicated to be coordinated.
g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
i. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

B. Perform coordination study and prepare a written report using the results of fault-current study and approved computer software program. Comply with IEEE 399.

C. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.

D. Comply with IEEE 242 recommendations for fault currents and time intervals.

E. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
b. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.

F. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

G. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.

H. Life safety coordination: The engineer of record interprets the code to allow for coordination above 0.1 seconds on the TCC for life safety systems, based on the acceptability of this approach in a much more critical building type listed in NFPA 99. Where possible, breakers shall be selectively coordinated via selective coordination tables instead of showing this coordination on the TCCs.

I. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
   c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
   d. Fuse-current rating and type.
   e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between series devices, including power utility company's upstream devices. Show the following specific information:

   a. Device tag.
   b. Voltage and current ratio for curves.
   c. Three-phase and single-phase damage points for each transformer.
   d. No damage, melting, and clearing curves for fuses.
   e. Cable damage curves.
   f. Transformer inrush points.
   g. Maximum fault-current cutoff point.

3. Completed data sheets for setting of overcurrent protective devices.

3.4 ARC FLASH STUDY

A. Provide a full Arc Flash Study as per IEEE 1584. The Study shall be based on the minimum available short circuit current from the Utility or the worst case scenario for arc flash current.

B. The preparer shall assume one iteration of balancing breaker settings against arc flash incident energy levels. The goal will be a maximum PPE Level of 2 or less for this project (except at the MDP, main section).

C. Provide and install Arc Flash labels on all electric equipment to comply with the latest editions of the NEC and IEEE 1584 and NFPA 70E.

3.5 OVERCURRENT PROTECTIVE DEVICE SETTING

A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to assist in setting of overcurrent protective devices within equipment.

B. Testing: Perform the following device setting and prepare reports:

1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:

a. Verify that overcurrent protective devices meet parameters used in studies.
b. Adjust devices to values listed in study results.

2. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures," and Tables 10.7 and 10.8 in NETA ATS.

END OF SECTION 260573

SECTION 260923 - DIGITAL NETWORK LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

B. The requirements of all other sections of Division 26, 27 and 28 apply to this section.

1.2 SUMMARY

A. Installed system shall be comprised of stand-alone and networked control devices as indicated. System control devices shall include, but are not limited to:

1. Digital Room Controllers
2. UL924 Load Controller
3. Fixture Control Modules
4. Lighting Control Panels
5. Sensors
6. Wall Stations
7. Network Area Controller
8. Network Modules
9. Network Accessories
10. Software Interfaces
11. Conductors and Cabling

1.3 SYSTEM DESCRIPTION

A. The contractor shall provide and install Distributed Intelligence Lighting Control System as shown on plans and specified herein. Distributed Intelligence Lighting Control System shall be designed and configured to send and receive control, monitoring, operating and maintenance signals and commands wired and or wirelessly to and from networked enabled room controllers, fixture modules, switch stations, occupancy and daylight sensors, lighting control panels and other controls devices.

1.4 SUBMITTALS

A. Prior to fabrication and shipment of lighting control components, manufacturer shall provide submittal documentation for approval.

B. Submittal documentation shall include:

1. Bill of Material including a list of components to be supplied,

2. Device specification sheets indicating device features, certifications, dimensions, construction specifications, electrical specifications, wiring diagrams, nomenclature, and related products,
3. Component schedules: Indicating lighting control device types and locations
4. Lighting panel schedules,
5. Wiring diagrams,
6. Control cable type and routing requirements,
7. System riser drawings of sufficient detail to indicate relative placement of major system components and the required connections between each,
8. Contractor Startup Request Form – to be completed prior to factory startup,
9. Operating and maintenance instructions, manuals and/or videos.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualification: Manufacturer of lighting control devices with minimum five years record of satisfactory manufacturing and support of components comparable to basis of design system.

1. Approval of Comparable Products: Submit the following at least 10 days prior to submission of a proposal package. Substitution submitted without the below shall be rejected.
   a. Submit line-by-line comparison that describes differences, if any, between each lighting control device specified and those being proposed. Comparison shall include differences in size, quantity, quality, method of control, features and functions, control software functions, and installation requirements.
   b. Product data, including certified independent test data indicating compliance with requirements.
   c. Samples of each component.
   d. Project references: Minimum of 3 installations not less than 3 years old, with Owner and Architect contact information.
   e. Sample warranty.
2. Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.

B. Factory Assembly: All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and network terminations. All connections shall be made to clearly and permanently labeled termination points or by connectorized cable. Systems that required field assembly shall not be acceptable.

C. Component Testing: All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.

1.6 SYSTEM COMPLIANCE

A. Compliance: Where indicated, individual components shall comply with the following requirements:

1. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) NFPA 70 as required.
2. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
3. UL Approval: All applicable equipment shall be tested to and listed under UL standard 508, UL standard 916 or UL924 and shall bare labels to indicate compliance. Lighting control relays shall be tested to UL standard 508 for both safety and endurance. Systems listed under ETL or other UL sections shall provide documentation proving compliance with UL standards as listed above.
4. FCC Emissions: All applicable equipment shall comply with FCC emissions standards specified in Part 15, sub-part j for commercial and residential applications and shall bear labels indicating compliance testing. Equipment that does not meet these standards shall not be acceptable.

1.7 WARRANTY

A. Manufacturer shall warrant the lighting control system components to be free from defects in material and workmanship for a period of five (5) years from the date of the certificate of building occupancy or proof of installation, whichever occurs first ("Warranty Period"). If the certificate of building occupancy is not available or there is no proof of installation, the Warranty Period shall begin with the Product ship date.

B. Manufacturer's warranty shall include the repair or replacement product(s) with the same or a functionally equivalent product(s) or component part(s).

C. Manufacturer shall provide telephone technical support and remote diagnostics where applicable during normal business hours excluding manufacturer holidays.

D. Upon request, Manufacturer shall provide quotation for manufacturer service contract option(s) which include on-site technician visits for service and repair.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers
   1. Cooper Lighting - LightLEEDer/EVO
   2. Acuity - N-Light
   3. Legrand - Wattstopper/DLM
   4. Or approved equal

B. Basis-of-Design: NX Lighting Controls System manufactured by HLI Solutions, a division of Current, Greenville SC.

2.2 SYSTEM ARCHITECTURE

A. System shall consist of wired and/or wireless, distributed intelligent lighting control devices consisting of but not limited to control modules with ON/OFF, full range dimming and CCT

control capabilities, and system input devices including but not limited to occupancy/vacancy sensors, daylight sensors and manual switch stations.

B. System shall provide for automatic self-configuration of system devices. Self-configuration shall be accomplished by the devices themselves and provide for control of lighting prior to system custom configuration and programming. Systems that require configuration prior to use shall be considered unacceptable.

C. To implement lighting control strategies, the system architecture shall facilitate the association of system input devices to control modules. The system shall use the Area/Zone/Group assignment strategy. The system shall support up to 128 Areas. Each area shall consist of up to 128 Zones and each zone shall consist of up to 16 Groups. Each device may be programmed to participate in one Area and Zone however may belong to one or more of the available 16 Groups within a Zone.

D. System shall provide time-of-day and astronomical clock scheduling. Each Area/Zone shall support up to 99 scheduled events for use in developing time-of-day or astronomical clock sunrise/sunset automated schedules. Each schedule shall have the ability to turn a group ON or OFF or activate a preset lighting scene at a scheduled time. Schedules shall be day-of-week selectable and may be programmed to activate on any combination of days of the week (Sunday through Saturday) or to activate on a specific date/holiday.

E. System shall support blink alerts. Relay outputs within the control modules shall be programmable to blink prior to being turned OFF. Blink alert duration time shall be adjustable. Control modules programmed for the blink alert function shall blink the controlled lighting prior to turning OFF to warn occupants of the upcoming OFF event. If an ON command is received during the blink alert time, relay output will be overridden and left ON for the override time. Override time shall be adjustable.

F. System input devices shall be deployed in a space to monitor and broadcast changes such as occupancy, daylight levels and manual switch input.

G. System customization and programming shall be performed from a mobile App and/or web-based configuration and system management tools.

H. System shall have an intuitive and easy to use Graphical User Interface (GUI) to configure, control, monitor and schedule individual devices or groups of devices.

I. System shall remain fully functional during the programming process. Lighting control systems that must be taken “OFFLINE” for programming are not acceptable. All programming changes shall take effect immediately as they are programmed.

J. System shall be capable of being accessed from a local network or remotely using any standard Internet browser. System shall not require any special client-side software. Systems which utilize special client-side software shall not be acceptable.

K. Systems devices shall be capable of communication with each over one or all of the below methods.

1. RS485 multidrop serial network
2. Wireless mesh network
3. Ethernet TCIP network

L. Wired – RS485/Ethernet

1. System shall provide an Ethernet communication backbone (HubbNET™) for the connection of control Zones.
2. System shall utilize the RS485 standard for connection of and communications between Zone Devices.
3. System shall utilize the RS485 standard for connection of and communications between SmartPORT™ devices (e.g., Sensors, Switches and Accessories) connected within a NX Zone.

M. System devices shall be capable of having their firmware updated or upgraded over the network.

2.3 DIGITAL ROOM CONTROLLERS

A. NX Room Controllers

1. Basis of Design Product: Hubbell Control Solutions, NX Room Controllers.
2. As indicated and where shown on the plans, install Hubbell Control Solutions NXRC series Room Controller(s) to control the quantity of lighting and plug loads required.
3. NX Room Controller(s) shall integrate the functionality of connected control components including wall switch stations, occupancy sensors and daylight sensors to provide the required sequence of operation for the space.
4. NX Room Controller(s) and associated room control components shall operate in a totally standalone mode and not require the use of a network, software, computer, or server for local control functions.
5. NX Room Controller(s) shall have an embedded Time Clock and be capable of storing and running up to 99 local schedules. Schedules shall run autonomously without the need of any coordinator, gateway, or master controller.
6. Construction:
   a. NX Room Controller housing shall be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.
   b. The housing and shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.
   c. Two RJ45 FX Port connectors shall be accessible on the side of the enclosure for expansion of a Zone Segment to allow for an expanded number of Zone Segment devices (e.g., Room Controllers, In-Fixture Modules, and Digital Sensors). Up to 32 controllers and devices can be daisy-chained together.
   d. Two RJ45 SmartPORT™ connectors shall be accessible on the side of the enclosure
   for the connection of NX room level devices.
   e. Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, setup, and testing functions.

7. Electrical:
   a. NX Room Controller(s) shall have a single power feed and shall be capable of operation at voltages between 120/277/347 volts AC, 50/60 Hz.
   b. One or two output relays (model specific) shall provide for the following load types and ampacity (per relay):
      1) 20A, Tungsten,
      2) 20A, Magnetic Ballast,
      3) 16A, Electronic Ballast,

4) 4) 1 H.P. Motor @ 120V, ¾ H.P. @ 277V; ½ H.P. @ 347V

c. Where indicated provide one or two independent 0-10 volt dimming channels (model specific) for full range dimming control of fixtures equipped with compatible dimmable ballast or driver.
d. Each dimming output shall have a current sinking capacity of at least 30 mA.
e. NX Room Controller(s) shall be capable of supplying 250 mA of Class 2 auxiliary DC power for use by wall switch stations, occupancy sensors, and daylight sensors connected to the room controller's two RJ45 SmartPORT connectors.
f. NX Room Controller(s) shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.

8. Functional:
   a. Provide an integral pushbutton and LED indicator for each load for status and to allow operation of the relays and dimmers for testing and verification without requiring other control devices to be connected.
   b. NX Room Controller(s) shall have a default operation providing an automatic logical sequence of operation for each load as the room control devices are plugged into the SmartPORT connectors.
   c. Default operation for occupancy sensors shall be automatic on, automatic off for all loads.
   d. Upon connection of a switch, the operation shall automatically change to manual on, automatic off (vacancy) mode for all loads.
   e. Provide capability to convert each load independently to automatic on or vacancy mode using only the integral push buttons and LED indicators on the room controller.
   f. When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.
   g. It shall be possible to connect up to thirty-two (32) room controllers together on the FX Ports using Cat5 patch cables to provide configurations up to 64 switched and dimmed loads operating as a single zone.
   h. Provide the following set up and configuration functions without the need for additional devices or software:
      1) Assign/reassign relays for control by wall switch station buttons,
      2) Configure relays for occupancy or vacancy operation,
      3) Assign/reassign dimmers to raise/lower switches,
      4) Assign dimming channels for response to daylight sensor control,
      5) Auto calibrate default daylight sensor sequence of operation,
      6) Save preset scenes.

9. NX Room Controller(s) shall support the following specialty modes:
   a. SpectraSync™ CCT Control
      1) Dimmer channels can be set individually to control CCT via 0-10V.
      2) Scheduling can be implemented to mimic the natural transition of light throughout the course of the day.
      3) Room-based solutions can be implemented to allow occupants to tune color to task.

   b. SpectraClean™
      1) Ability to control SpectraClean enabled fixtures with three different modes for varying applications:
         a) Constant On

b) Scheduled
c) Programmed Dosage

2.4 UL924 LOAD CONTROLLER

A. NX UL924 Load Controller

1. Basis of Design Product: Hubbell Control Solutions, NX UL924 Load Controller.
2. As indicated and where shown on the plans, install Hubbell Control Solutions NX UL924 Load Controller to control the quantity of emergency lighting loads required.
3. NX UL924 Load Controller shall meet NFPA Article 700 requirements for emergency lighting.
4. NX UL924 Load Controller and associated room control components shall operate in a totally standalone mode and not require the use of a network, software, computer, or server for local control functions.
5. NX UL924 Load Controller shall provide a remote test button or fire alarm interface.
6. NX UL924 Load Controller shall have an embedded Time Clock and be capable of storing and running up to 99 local schedules. Schedules shall run autonomously without the need of any coordinator, gateway, or master controller.
7. Construction:
   a. NX UL924 Load Controller housing shall be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.
   b. The housing and shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.
   c. Two RJ45 FX Port connectors shall be accessible on the side of the enclosure for expansion of a Zone Segment to allow for an expanded number of Zone Segment devices (e.g., Room Controllers, In-Fixture Modules, and Digital Sensors). Up to 32 controllers and devices can be daisy-chained together.
   d. Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, setup, and testing functions.

8. Electrical:
   a. NX UL924 Load Controller shall have a single power feed and shall be capable of operation at voltages between 120/277/347 volts AC, 50/60 Hz.
   b. One relay output shall provide the following load types and ampacity:
      1) 20A, Tungsten,
      2) 20A, Magnetic Ballast,
      3) 16A, Electronic Ballast,
      4) 4) 1 H.P. Motor @ 120V, ¾ H.P. @ 277V; ½ H.P. @ 347V.
   c. NX UL924 Load Controller shall provide two independent 0-10 volt dimming channels for full range dimming control of fixtures equipped with compatible dimmable ballast or driver.
   d. Each dimming output shall have a current sinking capacity of at least 30 mA.
   e. NX UL924 Load Controller shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.

9. Functional:
   a. SmartPORT Functionality:
      1) NX UL924 Load Controller shall automatically recognize connected devices in the Zone Segment.

2) NX UL924 Load Controller shall function as a standard room controller.
3) NX UL924 Load Controller's RJ45 CAT5 connection shall be used as a sensing
4) line to standard room controller only and does not support NX room devices.

b. Emergency Functionality:
1) NX UL924 Load Controller's RJ45 CAT5 connection shall be used as a sensing line to standard room controller on normal circuit.
2) Removal of 24VDC on CAT5 connection shall put NX UL924 Load Controller into emergency state.
3) NX UL924 Load Controller's default emergency state is ON with both dimming channels to 100%

c. Provide an integral pushbutton and LED indicator for controlled load for status and to allow operation of the relay and dimmers for testing and verification without requiring other control devices to be connected.

d. Provide the following set up and configuration functions without the need for additional devices or software:
1) Assign/reassign relays for control by wall switch station buttons,
2) Configure relays for occupancy or vacancy operation,
3) Assign/reassign dimmers to raise/lower switches,
4) Assign dimming channels for response to daylight sensor control,
5) Save preset scenes.

10. NX UL924 Load Controller shall support the following specialty modes:
a. SpectraSync™ CCT Control
1) Dimmer channels can be set individually to control CCT via 0-10V.
2) Scheduling can be implemented to mimic the natural transition of light throughout the course of the day.
3) Room-based solutions can be implemented to allow occupants to tune color to task.

b. SpectraClean™
1) Ability to control SpectraClean enabled fixtures with three different modes for varying applications:
a) Constant On
b) Scheduled
c) Programmed Dosage

2.5 FIXTURE MODULES

A. NX In-Fixture Modules

1. Basis of Design Product: Hubbell Control Solutions, NX In-Fixture Modules.
2. As indicated in the specifications and as shown on the plans, install Hubbell Control Solutions NXFM series Fixture Control Module enabled fixture(s).
3. NX In-Fixture Modules shall be designed to install inside the fixture they control.
4. NX In-Fixture Modules shall consist of a completely distributed intelligent lighting controller capable of functioning completely independently including time based and astronomical scheduling of On/Off and preset events without the need of any coordinator, gateway or master controller. Sensors and switches as well as other NX In-Fixture enabled fixtures shall be capable of being connected directly to the NX In-Fixture Module to create a fully functional lighting control system.

5. NX In-Fixture Module shall be provided with one SPST relay. Relay shall be supplied with "Zero Cross Switching" control to limit the effects of inrush on the relay contacts.
6. NX In-Fixture Module shall be compatible with incandescent, magnetic, and electronic lighting loads including LED drivers. NX In-Fixture Module shall include zero arc point switching circuitry and have the following max load ratings:
7. Construction:
    a. Housing: GSM UL Rated 94 HB Plastic
    b. Mounting: Mounts inside fixture

8. Electrical:
    a. Line Voltage Versions:
        1) Input: Universal 120-347VAC, 50-60Hz
        2) Output: One or two relay outputs (model specific) shall provide for the following load types and ampacity (per relay):
            a) 10A, 120VAC only Incandescent
            b) 10A, 120-347VAC, Magnetic Ballast
            c) 5A, 120-277VAC, Electronic Ballast
            d) 3A, 347VAC, Electronic Ballast
        3) Surge Withstand: 2000V
        4) Peak Inrush: 160A for 2 ms Max
    b. Low Voltage Versions:
        1) Input: 12-24VDC
    c. NX In-Fixture Modules shall be provided with two 0-10VDC control interfaces for full range dimming control of dimming ballasts and LED drivers. Interface shall be designed to continuously sink 30mA of current.
    d. NX In-Fixture Module 0-10VDC control interfaces shall be configurable for 0-10VDC dimming, dim to off or color temperature control.

9. Functional:
    a. NX In-Fixture Modules shall be designed to self-configure, automatically to meet energy code requirements as NX sensors and other NX devices are connected.
    b. NX In-Fixture Module shall be designed such that self-configuration takes place automatically without user intervention or commissioning of any kind.
    c. NX In-Fixture Modules shall be rated and tested for an operating temperature range of -40° to 185°F [-40° to 85°C].
    d. NX In-Fixture Module shall be equipped with a Real Time Clock and integral backup for schedule information. Each module shall support up to 99 schedules. Schedules shall be loaded to the module via the network or locally using the NX controlHUBB App. Once loaded, schedules shall run autonomously without the need of any coordinator, gateway, or master controller.
    e. NX In-Fixture Module shall be capable of having its device firmware updated wirelessly over the air when connected to a NX sensor of via the NX SmartPORT.
    f. NX In-Fixture Modules shall be supplied with one momentary pushbutton with LED for manual control and testing. Through the use of this switch, it shall be possible to test the On/Off and dimming functionality of the NX In-Fixture module or completely reset the NX In-Fixture Module to factory defaults without the need to connect any other device or testing equipment.
    g. NX In-Fixture Module shall include non-volatile memory for retaining device settings during power outages.

10. NX In-Fixture Module shall be UL Listed to UL916 and Certified to CAN/CSA C22.2 NO 205- M1983.
11. NX In-Fixture Module shall be FCC certified.

B. NX On-Fixture Modules
1. Basis of Design Product: Hubbell Control Solutions, NX On-Fixture Module.
2. As indicated in the specifications and as shown on the plans, install Hubbell Control Solutions NXOFM series wireless On-Fixture Control Module(s).
3. NX On-Fixture modules shall consist of a completely self-contained distributed intelligent wireless lighting controller capable of functioning completely independently including time based and astronomical scheduling of On/Off and preset events without the need of any coordinator, gateway or master controller.
4. NX On-Fixture Module shall be configurable remotely over the air utilizing built in Bluetooth radio an iOS or Android handheld device with the NX controlHUBB App installed or via NX Wireless HubbNET network.
5. NX On-Fixture Module shall be capable of having its device firmware updated wirelessly over utilizing it's built in Bluetooth radio and iOS or Android handheld device with the NX controlHUBB App installed or via NX Wireless HubbNET.
6. On-Fixture Module shall respond to scheduled events, occupancy/vacancy sensor events and manual switch station events.
7. On-Fixture Module shall monitor and measure energy consumption.
8. On-Fixture Module shall include non-volatile memory for retaining device settings during power outages.
9. NX On-Fixture Modules shall be rated and tested for an operating temperature range of -40° to 185°F [-40° to 85°C].
10. NX On-Fixture Module shall include one SPST relay for On/Off control.
11. NX On-Fixture Modules relay shall be supplied with "Zero Cross Switching" control to limit the effects of inrush on the relay contact.
12. NX On-Fixture Module shall be compatible with incandescent, magnetic, and electronic lighting loads including LED drivers.
13. Construction:
    a. Housing: GSM UL Rated 94 HB Plastic
    b. Mounting: Standard C136-41 (2013) with 5 or 7 pin twist-lock connector. Compatible with C136-10 sockets.

14. Electrical:
    a. Input: 120-480VAC, 50-60Hz
    b. Output: Relay output shall provide for the following load types and ampacity:
        1) 5A@120-347VAC,
        2) 3A@480V
    c. Surge Withstand: 2000V
    d. Peak Inrush: 160A for 2 ms Max
    e. Standby Power (W):
        1) 120VAC: 1.2
        2) 277VAC: 1.5
        3) 347VAC: 1.5
        4) 480VAC: 1.3

15. Functional:
    a. On-Fixture Module shall include an integrated daylight sensor with a foot candle range as shown below:

1) On level: 1FC to 5FC (Default: 5FC)
2) Off level: 4FC to 15FC (Default: 8FC)

b. NX On-Fixture Modules shall communicate with other NX enabled fixtures and devices via HubbNET wireless mesh network with the following characteristics:
1) Robust & reliable IEEE 802.15.4 2.4GHz wireless self-organizing and self-healing mesh network
2) Radio Range: Outdoor: ~1000 ft. (~300m) Note: Range based on clear line of site.
3) Security: AES-128 (Advanced Encryption Standard)

16. NX On-Fixture Module shall include non-volatile memory for retaining device settings during power outages.
17. NX On-Fixture Module shall UL Listed to UL916 and Certified to CAN/CSA C22.2 NO 205- M1983.
18. NX On-Fixture Module shall be FCC certified.

2.6 LIGHTING CONTROL PANELS

A. NX Lighting Control Panels

1. Basis of Design Product: Hubbell Control Solutions, NX Lighting Control Panels.
2. As indicated and where shown on the plans, install Hubbell Control Solutions NX Series Lighting Control Panels.
3. Panel shall be a fully distributed intelligent lighting controller with the ability to function as a stand-alone lighting control panel or as part of an NX networked system.
4. Panel shall provide standard capacities for 8, 16, 24, 32, or 48 relays in each panel with matching number of 0-10v dimming channels.
5. Panel shall be available in custom configurations. Configuration options shall include: panel shipment type (enclosure/interior shipped together, enclosure/interior shipped separately, enclosure only, and interior only), panel size, number of single pole/double pole relays, emergency control option, input voltage and enclosure mount (surface mount or flush mount).
6. Panels shall be factory assembled and tested. No field assembly shall be required.
7. Construction:
   a. Panel shall be surface or flush wall mounted in a NEMA1 rated enclosure, based on panel configuration.
   b. Panel shall be capable of being shipped with enclosure/interior together, enclosure/interior separately, enclosure only, and interior only in appropriately designed packaging. When enclosure is shipped separately, enclosure shall enable rough-in of all electrical connections prior to receipt of the panel interior.
   c. Panel enclosure shall have standard electrical conduit knockouts on the top, the bottom and both sides of the enclosure to allow installation flexibility. Field drilling and cutting for pipe and wire shall not be required.
   d. Panel shall provide keyhole mounting holes in the rear of the enclosure.
   e. Panel enclosure shall include 6” spacing running the width of the panel at the bottom of the panel to allow for line voltage accessories such as contactors or to provide a “gutter”. Space shall be separated from the low voltage area utilizing a removable metal barrier. No knockouts added to the bottom plate of the inner high voltage divider. Exterior enclosure will maintain knockouts on bottom.

f. Panel venting shall conform to NEMA 1 enclosure specifications to contain any local explosion and to protect the working environment.
g. Panel enclosure shall feature removable metal barriers that separate all high-voltage components and wiring (Class 1) from all low-voltage (Class 2) components and wiring.
h. Panel enclosure shall be of welded construction primed and painted with a powder coat finish. Unpainted or galvanized enclosures are not acceptable.
i. Panel cover shall attach to the enclosure with #10-32 x ½" truss head machine screws.
j. Panel cover shall employ "keyhole" style openings for the top two mounting screws to allow the panel's cover to be temporarily hung during installation eliminating the need to completely remove all the mounting screws along with contributing to safety ensuring the cover does not swing if all screws were removed.
    1) 8 Relay panel cover – 4 mounting holes: 2 keyhole style slots, 2 slotted style slots
    2) 16/32 Relay panel cover – 6 mounting holes: 2 keyhole style slots, 4 slotted style slots
    3) 48 Relay panel cover – 8 mounting holes: 2 keyhole style slots, 6 slotted style slots

k. Panel cover shall be sized for either surface or recess mounting of the panel.
l. Panel cover shall have hinged locking door to expose only the low voltage wiring section of the panel.
m. Panel door hinges shall be located on the left side.
n. Panel shall be provided with a factory or field installable panel interior. Panel interior shall contain all controller electronics, power supplies, relays, and other required components. Panel shall arrive at the project site completely pre-wired and requiring only the connection of lighting circuits and network cable. Systems that require field assembly of controllers or chassis inserts are not acceptable
o. Panel interior components shall reside on a framed skeleton. When disconnected from the load circuits and necessary mounting connections, the framed skeleton can be removed taking all the electrical components intact.
p. Panel interior components shall be designed to not become dislodged during shipment.
q. Panel spacing between panel relays shall be suitable for separating any two relays in the panel to meet the NEC requirements for normal and emergency power when a metal divider is installed between relays. A metal plate barrier shall be available to separate relays - two plates per application.
r. Panel relays shall be of the snap-in type and be individually field replaceable.

8. Electrical:
    a. Panel shall be supplied with either a 120V/277V, 347V or 480V power supply.
    b. Panel power supply shall provide the required capacity for the operation of the panel, relays, controllers, HubbNET PoE, SmartPORTs, user interfaces and the maximum number of low voltage and/or data devices that can be connected to each panel.
    c. Panel wire connections shall be made to labeled terminal blocks.
    d. Panel shall have LED status/failure indicators.
    e. Panel shall provide support for Bluetooth programming using the NX controlHUBB app and the NX Bluetooth Radio Bridge with Clock or a SmartPORT connected NX sensor.

f. Panel shall include two (2) Ethernet ports for connection to the NX HUBBnet network.
g. Panel shall include four (4) RJ45 NX SmartPORTs for the connection of all NX sensors and switches. SmartPORTs shall be capable of supplying 250 mA of Class 2 auxiliary DC power for use by wall switch stations, occupancy sensors, and daylight sensors connected to the SmartPORT connectors
h. Panel shall have four (4) 3-wire low voltage dry contact inputs. Removable terminal blocks shall be provided to support momentary or maintained closures from building automation systems, fire systems, demand response and security systems as well as other systems or devices including occupancy sensors, daylight sensors, and low voltage switches. Each input shall be individually programmable and provide the ability to initiate any NX switch compatible function or command. (on, off, raise, lower, preset, timed on/off). Each input will provide a connection for sourcing 24V, a common, control and pilot light functionality for low voltage switch stations.
i. Panel shall have two (2) SPDT (NO/NC) dry contact outputs, with removable terminal blocks, to provide a contact closure to signal out to another system that is capable of receiving a NO or NC closure to signal building automation, security or alarm system based on a schedule or a command from an input device (e.g. occupancy sensor, daylight sensor, wall switch station, etc.). Each output will have a contact rating of 24VDC@50mA minimum.
j. Panel shall have an easily accessible, removable coin size battery for maintaining system time during a power loss.
k. Panel shall, after a power loss, retain time for a minimum of 72 hours.
l. Panel time shall be updated when connected to a device utilizing the NX controlHUBB app or from an NX network time server.
m. Panel shall feature an optional power sensing circuit and backup battery for UL924 operation. Upon detection of loss of power, the panel shall force all relays closed and all dimming channels to full bright. Panel shall maintain this state for 90 minutes. Connected devices will not be powered.
n. Panel shall have a battery test button on the optional power sensing circuit to test the battery with a derangement (audio) signal and LED indicators.
o. Panel shall provide relay/dimmer boards to expand panel capacity from 8 to 48 relay outputs in groups of 8. Relay/dimmer boards shall be completely self-configuring and shall not require manual settings to configure for use within the panel.
p. Panel relay/dimmer boards shall confirm relay presence and status.
q. Panel relay/dimmer boards shall have (8) 0-10V integrated dimming channels, each capable of sinking 50mA.
r. Panel dimming channels shall be software assignable.
s. Panel shall be capable of containing 1 to 48 robust and reliable mechanically latching lighting control relays as indicated on the drawings and schedules as specified herein. Electrically held or non-mechanically latching relays shall not be considered.
t. Panel relays shall be individually UL and CUL listed and shall bear labels indicating compliance. Lighting control relays shall be tested to UL standard 508 for both safety and endurances and bare labels signifying compliance.
u. Panel relays shall have the following load ratings:
    1) Single Pole Relays:
        a) General Use: 30A @ 300VAC
        b) Tungsten: 2400W @ 120VAC
        c) Standard Ballast: 20A @ 300VAC

d) Motor Starting: 1HP @ 110-125VAC; 1½ HP @ 220-277VAC

2) Double Pole Relays:

a) General Use: 20A @ 480VAC

b) Tungsten: 2400W @ 120VAC

c) Standard Ballast: 20A @ 480VAC

d) Motor Starting: 1HP @ 110-125VAC; 1½ HP at 220-277VAC

v. Panel relays shall be rated for minimum cycle life of 120,000+ operations (60,000+ cycles).

w. Panel relays shall have a Short Circuit Current Rating (SCCR) of 18,000A @ 277VAC.

x. Panel relays shall have a built-in manual override lever & ON/OFF indicator.

y. Panel relays shall be capable of manual activation On or Off with or without power.

9. Functional:

a. Panel shall be of the distributed intelligence type and shall not be dependent on a network connection to execute schedules or perform programmed functions.

b. Panel shall be programmed using the optional NXBTC Bluetooth® radio module with clock and NX Bluetooth controlHUBB App. When networked, panel configurations shall be performed utilizing the NX Area Controller's web-browser based Graphical User Interface.

c. Panel shall provide the ability to update panel firmware. Firmware update process shall ensure that the complete and correct firmware (e.g. via CRC check) has been downloaded before the panel is flashed with the new firmware.

d. Panel set up and configuration functions shall include (but are not limited to):

1) Assign/reassign relays for control by wall switch station buttons,

2) Configure relays for occupancy or vacancy operation,

3) Assign/reassign dimmers to raise/lower switches,

4) Assign dimming channels for response to daylight sensor control,

5) Assign names to relays/dimmers,

6) Auto calibrate default daylight sensor sequence of operation,

7) Create and save preset scenes,

8) Configure wall switch button types. At a minimum, button types shall include toggle on/off with pilot, preset, on only and off only,

9) Configure up to six zones of daylight harvesting per room with independent set points and time delays,

10) Include or exclude loads from occupancy sensor control,

11) Configure up to 16 load groups per zone,

12) Configure up to 16 preset scenes per zone with independent fade times,

13) Set independent power up conditions for relays and dimmers,

14) Set independent occupied and unoccupied conditions for each relay and dimmer,

15) Adjust dimmer high and low trim points,

16) Manually control lighting loads

e. Panel shall provide the ability to create up to ninety-nine (99) schedules. Each schedule will consist of the following:

1) Event Time – Shall be configured as a specific set "Normal" time (hh:mm am/pm) or as an offset based on one of the following: Before Sunrise, After Sunrise, Before Sunset, After Sunset, Before Open, After Open, Before Close or After Close.

2) Action – Task to be performed: None, Group State, or activation of a Preset.

3) None – No action to perform
4) Group State – The specific relay / dim level / color temp range settings, that the select group(s) of actuators should implement.
5) Presets – The specific preset that should be activated.

f. Panel shall provide the ability to disable a schedule
g. Panel shall provide the ability to delete a schedule

2.7 CONTROLLED RECEPTACLES

A. HCS Controlled Receptacle

1. Basis of Design Product: Hubbell Control Solutions, HCSREC Series Controlled Receptacle.
2. Controlled Receptacle shall be capable of controlling other receptacles downstream in the branch circuit.
3. Controlled Receptacle shall be automatically controlled by a low voltage signal from an occupancy sensor or any other type of control capable of performing this task, e.g., time-of-day control device.
4. Controlled Receptacle shall be available in split or fully controlled 15A or 20A models.
5. Controlled Receptacle shall feature permanent NEC 406.3 (E) markings.
6. Controlled Receptacle shall be UL498B SA Listed Receptacles with integral switching that complies with Supplement SA.

2.8 SENSORS

A. NX Occupancy Sensors, Wired

1. Basis of Design Product: Hubbell Control Solutions, NX Occupancy Sensors.
2. NX Occupancy Sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared), ultrasonic and/or passive infrared (model specific) sensing technology as indicated.
3. NX Occupancy Sensors shall be Class 2 and connect to any room controller SmartPORT using a wiring adaptor and standard Cat5 patch cable.
4. NX Occupancy Sensors shall be microprocessor controlled and utilize IntelliDAPT® technology to optimize sensor behavior to adapt to space conditions and occupant usage patterns and adjust sensitivity and time delay to maximize energy savings and minimize false On and Off events
5. NX Occupancy Sensors shall be self-adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically adjust the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.
6. NX Occupancy Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.
7. Up to four NX Occupancy Sensors may be connected to one room controller.

B. NX Occupancy Output Interface

1. Basis of Design Product: Hubbell Control Solutions, NXRO Series Occupancy Output Interface Module.

2. NX Occupancy Output Interface shall communicate the occupancy state of an NX control zone to HVAC or other building systems using a contact closure.
3. NX Occupancy Output Interface shall connect to a SmartPORT™ and provide the aggregate occupancy state of the zone as reported by one or more occupancy sensors.
4. NX Occupancy Output Interface shall mount to a standard 4 11/16" junction box.
5. NX Occupancy Output Interface shall have a removable terminal block for input connection.
6. NX Occupancy Output Interface shall be powered by NX SmartPORT.
7. NX Occupancy Output Interface shall support multiple occupancy sensors in a zone.
8. NX Occupancy Output Interface shall feature a low voltage Form-C relay for Normally Closed / Normally Open operation.
9. NX Occupancy Output Interface shall be a low voltage device: 24VDC.

C. NX Daylight Sensor, Wired

1. Basis of Design Product: Hubbell Control Solutions, NXDS Series Daylight Sensor.
2. NX Daylight Sensor shall provide ambient light level information to the room controller allowing daylight responsive lighting control.
3. The system shall operate in an open loop sequence of operation reducing the amount of electric light as the quantity of daylight entering the room increases.
4. It shall be possible to configure up to six daylight zones in a room. Each zone shall be programmable to proportionally respond to the light level provided by the daylight sensor.
5. NX Daylight Sensor shall be mounted vertically or horizontally and positioned to provide an unobstructed view of the windows per the manufacturer's directions.
6. NX Daylight Sensor shall be available in indoor and outdoor models.
7. NX Daylight Sensor shall have an architecturally attractive design.
8. NX Daylight Sensor shall have a foot-candle range: 3-6,000FC

D. NX Wall Partition Sensor

1. Basis of Design Product: Hubbell Control Solutions, NXWPS Series Wall Partition Sensor.
2. NX Wall Partition Sensor shall automatically signal to the NX lighting control system when a moveable partition has been opened or closed. This allows the two adjacent rooms to be combined or separated into individual rooms.
    a. NX controls shall automatically reconfigure to operate in unison when rooms are combined.
    b. NX controls shall automatically reconfigure to operate independently when the rooms are separated.
    c. NX system shall allow for room combine scenarios with up to 16 combinable rooms.
3. NX Wall Partition Sensor shall be a low voltage device: 24VDC.

E. NX Contact Closure Interface

1. Basis of Design Product: Hubbell Control Solutions, NXCI Series Contact Closure Interface.
2. NX Dry Contact Closure Interface shall enable third-party devices to provide dry contact inputs to the NX lighting control system.
3. NX Dry Contact Closure Interface shall provide switch activation using contact closures from external devices such as key switches, AV systems, photo-eye sensors or other low voltage Class 2 devices.

4. NX Dry Contact Closure Interface shall default to On/Off operation and can be programmed to perform alternate functions including:
   a. Toggle On/Off
   b. Preset
   c. Raise
   d. Lower
   e. Timed On
5. NX Dry Contact Closure Interface shall feature a removable terminal block for input connection.
6. NX Dry Contact Closure Interface shall feature pilot light output terminals.
7. NX Dry Contact Closure Interface shall be a low voltage device: 24VDC.

2.9 WALL STATIONS

A. NX SimpleTouch™ Graphic Wall Station

1. Basis of Design Product: Hubbell Control Solutions, NX SimpleTouch Graphic Wall Station.
2. Graphic Wall Station shall employ a 3.5" resistive LCD-TFT, full-color touch screen with 320x480 screen resolution in portrait orientation.
3. Graphic Wall Station shall mount to a standard single gang switch box.
4. Graphic Wall Station shall utilize standard Cat5 cabling for connection to system SmartPORT. Provide two RJ45 ports to allow daisy chain connection with other NX Smart Switches.
5. Graphic Wall Station shall operate seamlessly with other NX Smart Switches.
6. Graphic Wall Station shall provide a 4GB microSD card for storing user preferences that include the quantity of controls per screen, function names, screen navigation, home screen selection, and custom screen saver graphic image.
7. Graphic Wall Station screens can be configured to meet project requirements for control of up to 16 groups, each with provision for On/Off and dimming, up to 16 preset scenes, or CCT color control.
8. Graphic Wall Station shall be capable of local control within a single space or configured for master control across spaces or building wide.
9. Graphic Wall Station shall have an optional password access control that will require a secure PIN to access the station.
10. Graphic Wall Station shall have adjustable screensaver timeout and backlight brightness.
11. Graphic Wall Station shall be supplied with a white bezel. Optional color change kit shall allow for Ivory, Grey, Light Almond, or Black.

B. NX Smart Switches

1. Basis of Design Product: Hubbell Control Solutions, NX NXSW Series Smart Switches.
2. NX Smart Switches shall be of the programmable type using standard Cat5 cabling for connection to system SmartPORT™.
3. NX Smart Switches shall have one to six buttons and provide lighting control functions as called out and shown on the plans.
4. NX Smart Switches shall be available with the following specialty versions:
   a. OO: On/Off
   b. ORLO: On/Raise/Lower/Off
   c. RL: Raise/Lower
   d. TO: Timed-On

e. SS: Scene

5. Construction:
   a. Housing: Rugged, high impact, injection molded plastic
   b. Mounting: Switches shall be capable of being mounted to single-gang and multi-gang wall boxes and shall be compatible with standard decorator style wall plates.
6. Electrical:
   a. Class 2 Low Voltage 24VDC
   b. Connection via two (2) RJ-45 SmartPORTs to allow for daisy chain connection of up to eight switches to each SmartPORT.
7. NX Smart Switches shall be available in White, Ivory, Light Almond, Gray, Black, and Red.

C. NX Audio Visual Interface Module

1. Basis of Design Product: Hubbell Control Solutions, NXAVM Series Audio Visual Interface Module.
2. NX Audio Visual Interface Module shall enable third-party systems to digitally interface with an NX light control system.
3. NX Audio Visual Interface Module shall provide an ASCII based command set to interface with third-party systems such as Audio-Visual systems to send commands to and receive query status from a NX system
4. NX Audio Visual Interface Module shall feature a DB9 connector and support RS232 serial communication, providing control and status for a single zone.
5. NX Audio Visual Interface Module shall mount to a standard 4 11/16" junction box.

2.10 NETWORK AREA CONTROLLER

A. NX Area Controller

1. Basis of Design Product: Hubbell Control Solutions, NXAC Series Area Controller.
2. NX Area Controller shall provide a simple and highly intuitive graphical user interface (GUI) to the NX Distributed Intelligence Lighting Control System via a personal computer.
3. NX Area Controller shall enable any PC with a standard web-browser to interface with the NX system through a built-in web server.
4. NX Area Controller shall enable system users to easily program, monitor and control (locally or remotely) the functions of the NX system.
5. NX Area Controller shall connect to the NX HubbNET™ network providing communication with the NX Room Controllers, NX Lighting Control Panels, NX SmartPORT™ Modules and other wired NX system components.
6. NX Area Controller shall have the ability to communicate by means of TCP/IP over Ethernet allowing enterprise connectivity between the NX Distributed Lighting Control System and external LAN or WAN networks.
7. NX Area Controller shall use NX Wireless Access Points to extend connectivity to NX Wireless Room Controllers and Fixture Modules.
8. NX Area Controller shall be capable of communicating with Building Automation System via an embedded BACnet™ client using the BACnet IP protocol.
9. NX Area Controller shall enable the connection of multiple users simultaneously.
10. NX Area Controller shall feature user account/password management.
11. Construction:

a. NX Area Controller electronics shall be housed in a NEMA 1 industrial grade enclosure suitable for surface wall mounting in an electrical/mechanical room.
b. The enclosure shall measure 13.5" H x 14.5" W x 4" D and include a screw on cover with a hinged locking door.
c. Provide standard knock outs eliminating the need for field drilling or cutting of the enclosure which could damage the electronics.

12. Electrical:
    a. NX Area Controller shall have a 120VAC, 60Hz hard wired supply connection. Servers or controllers using plug-in type power sources shall not be acceptable.
13. Functional:
    a. NX Area Controller shall function as a web server allowing the user interface to be accessible through a standard web browser.
    b. The installation of software shall not be required. At a minimum, the user interface shall provide the following functions:
        1) Automatic discovery of NX system devices
        2) Commissioning of devices into logical Areas and Zones, provide a minimum of 128 areas each with 128 zones
        3) Display the entire system in a logical navigation tree view
        4) Allow the user to name Zones, Groups, Presets, Schedules and individual loads
        5) Set up control functions for system inputs and outputs
        6) Monitor status and override individual relays and dimmers
        7) Set up and download schedules to panels and room controllers
        8) Monitor real-time power use at each room controller

2.11 NETWORK MODULES

A. NX Network Bridge Module

1. Basis of Design Product: Hubbell Control Solutions, NX Network Bridge Module.
2. NX Network Bridge Module shall allow multiple room controller zones to be networked with other NX system devices for whole building administration of lighting control functions.
3. NX Network Bridge Module housing shall measure 5.75" X 3.85" X 1.3"and be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.
4. NX Network Bridge Module shall connect to and be powered from a room controller SmartPORT via a standard Cat5 cable.
5. NX Network Bridge Module shall provide RJ-45 ports for in and out connection points for an Ethernet based network.
6. NX Network Bridge Module shall provide a communication link between the room control devices and the NX system Area Controller via an Ethernet based network. At a minimum, the network link shall provide the following functionality through a web browser user interface:
    a. Report the current occupancy status for each lighting control zone
    b. Indicate the status of each relay and dimming channel
    c. Allow reconfiguration of system device input and output parameters
    d. Report the real time power consumption for each Room Controller
    e. Set up daylight harvesting for zones equipped with photocells
    f. Configure and download schedules to panels and Room Controllers

B. NX HubbNET™ Radio Module

1. Basis of Design Product: Hubbell Control Solutions, NXRM Series HubbNET Radio Module.
2. NX HubbNET Radio Module shall allow a luminaire equipped with the NXFM In-Fixture Module to be promoted wirelessly from standalone operation to full network participation.
3. NX HubbNET Radio Module shall plug into the SmartPORT™ connector on the NXFM In- Fixture Module and is mounted through an 1.25" aperture in the luminaire housing.
4. NX HubbNET Radio Module shall feature a low-profile housing for minimal visual impact.
5. NX HubbNET Radio Module shall feature an O-ring gasket to provide watertight seal to luminaire housing.
6. NX HubbNET Radio Module shall have an integrated and compact PCB F antenna and shall not require an external antenna.
7. NX HubbNET Radio Module shall integrate seamlessly into the NX HubbNET network.
8. NX HubbNET Radio Module shall have an RF frequency of 2.4GHz.

C. NX Network Interface Module:

1. Basis of Design Product: Hubbell Control Solutions, NXDHI Series Device Network Interface Module.
2. NX Network Interface Module shall provide network connection and power to accessory components including NX Dry Contact Interface and NX SmartPORT Modules.
3. NX Network Interface Module shall be discoverable by the NX Area Controller and controllable through web browser interface.
4. NX Network Interface Module shall repeat network communication signal to extend network length.
5. NX Network Interface Module shall feature integral link indicators confirming network segment status.
6. NX Network Interface Module shall feature a power LED indicator confirming presence of accessory DC power on NX HubbNET segment.
7. NX Network Interface Module shall feature dual RJ45 HubbNET input and output jacks to enable module to be inserted anywhere along the HubbNET network as needed.
8. Construction:
    a. Extruded and sheet aluminum
    b. Weight: 6 oz (170.1g)
    c. Mounting: 1.38" (35mm) DIN rail
9. Electrical:
    a. Input: 24VDC, 800mA max current via HubbNET network cable
    b. Output: 24VDC power supplied to connected accessory modules
10. NX Network Interface Module shall be Title 24 Compliant.

D. NX SmartPORT Module

1. Basis of Design Product: Hubbell Control Solutions, NX SmartPORT Module.
2. NX SmartPORT Module shall provide the ability to easily connect smart switch stations, motion detectors, and daylight sensors into the NX network system.
3. NX SmartPORT Module shall have (4) SmartPORTs each with (2) RJ45 connectors for convenient connection of multiple devices.
4. Devices connected to the SmartPORT module shall be network visible and configurable to operate with panels and room controllers via the web browser user interface.
5. NX SmartPORT Module shall be compatible with all NX Smart Switch Stations, NX Occupancy Sensors and NX Daylight Sensor.

6. NX SmartPORT Module shall feature DIN rail mounting.
7. NX SmartPORT Module shall be a low voltage device: 24VDC.

E. NX Dry Contact Interface Module

1. Basis of Design Product: Hubbell Control Solutions, NXDCIO Series Dry Contact Interface Module.
2. NX Dry Contact Interface Module shall provide a simple way to incorporate standard dry contact inputs and outputs into the NX lighting control system.
3. NX Dry Contact Interface Module shall accommodate dry contact input closures from building automation, fire, security, and many other types of systems.
4. NX Dry Contact Interface Module shall be programmable from the NX Area Controller.
5. NX Dry Contact Interface Module shall feature (6) individually programmable dry contact inputs with or without pilots.
6. NX Dry Contact Interface Module shall accommodate 2 and 3 wire inputs (momentary or maintained).
7. NX Dry Contact Interface Module shall feature (6) individually programmable Form-C dry contact outputs.
8. NX Dry Contact Interface Module shall have removable terminal blocks for easy connections.
9. NX Dry Contact Interface Module shall feature DIN rail mounting.
10. NX Dry Contact Interface Module shall be a low voltage device: 24VDC.

2.12 NETWORK ACCESSORIES

A. NX Bluetooth® Radio Bridge with Real Time Clock

1. Basis of Design Product: Hubbell Control Solutions, NXBTC Series Bluetooth Radio Controller.
2. NX Bluetooth Radio Bridge with Real Time Clock shall provide a wireless communication bridge for communications via iOS® or Android™ smart device apps.
3. NX Bluetooth Radio Bridge with Real Time Clock shall connect to and be powered by an NX SmartPORT™.
4. NX Bluetooth Radio Bridge with Real Time Clock shall use Bluetooth technology allowing the radio to easily pair with a smart phone or tablet.
5. NX Bluetooth Radio Bridge with Real Time Clock shall communicate with the NX system for setup and control from a smart device.
6. NX Bluetooth Radio Bridge with Real Time Clock shall feature a real time clock and allow schedules to be downloaded and run in stand-alone NX Room Controller applications without a network.
7. NX Bluetooth Radio Bridge with Real Time Clock shall provide password protections for user access preventing unauthorized Bluetooth connection of a smart device.
8. NX Bluetooth Radio Bridge with Real Time Clock shall use Bluetooth Version 4.1.
9. NX Bluetooth Radio Bridge with Real Time Clock shall feature an LED status indicator for successful connections.
10. NX Bluetooth Radio Bridge with Real Time Clock shall have a RJ45 plug-in connection to NX SmartPORT.
11. NX Bluetooth Radio Bridge with Real Time Clock shall be a low voltage 24VDC device.
12. NX Bluetooth Radio Bridge with Real Time Clock shall be rated for return air plenum

B. NX Media Converter

1. Basis of Design Product: Hubbell Control Solutions, NXEOF Series Media Converter.
2. NX Media Converter shall allow a transition from copper based ethernet to fiber.
3. NX Media Converter shall support 10BASE-T, 100BASE-TX, 100BASE-FX and IEEE 802.3 specifications.
4. NX Media Converter shall be a multimode converter and support up to 5km distance.
5. NX Media Converter shall include and RJ45 port that supports full/half-duplex auto-negotiation and MDI/MDIX auto-crossover.
6. NX Media Converter shall include LED indicators for RJ45 and fiber port status.
7. NX Media Converter shall include a wall mounting kit.

C. NX HubbNET™ PoE Switch

1. Basis of Design Product: Hubbell Control Solutions, NXPOE Series PoE Switch/Power Injector.
2. NX HubbNET PoE Switch shall provide the splitting of the HubbNET network from the NX Area Controller into multiple segments.
3. NX HubbNET PoE Switch shall provide seven powered RJ45 ports for connection of NX network devices.
4. NX HubbNET PoE Switch shall provide multiple dimming options including DMX to less than 0.1%.
5. NX HubbNET PoE Switch shall expand the capacity of the NX Area Controller to 448 bridges suitable for large commercial and architectural interiors.

D. NX Forward and Reverse Phase Dimming Converter

1. Basis of Design Product: Hubbell Control Solutions, NX Forward and Reverse Phase Dimmer Converter.
2. NX Forward and Reverse Phase Dimmer shall auto-sense forward and reverse phase dimming.
3. NX Forward and Reverse Phase Dimmer shall dim standard 120V or 277V lighting loads.
4. NX Forward and Reverse Phase Dimmer shall support up to 1300W max load.
5. NX Forward and Reverse Phase Dimmer shall provide dual 0-10V input and output ports.
6. NX Forward and Reverse Phase Dimmer shall provide an integrated 6.5ft flexible conduit.
7. NX Forward and Reverse Phase Dimmer shall be compatible with NX Room Controllers, NX Lighting Control Panels and Hubbell Control Solutions Low Voltage Dimming Switches.
8. Construction:
    a. Housing: Anodized aluminum
    b. Size: 4.01” L x 5.52” W x 1.88” H
    c. Complies with requirements for use in a plenum area
    d. Mounting: Surface mount with screws
9. Electrical:
    a. Input: 120/277VAC, 60Hz – Single feed input connection
    b. Output: 120/277VAC, 60Hz – Single feed output connection
    c. Low Voltage: Class 2, 0-10V Input and output
    d. Max Load Rating:
        1) 1) 120VAC: 700W
        2) 2) 277VAC – 1300W
    e. Min Load Rating: 24W
    f. Standby Power:
        1) 1) 120VAC: 0.75W

2) 2) 277VAC: 1.87W

g. Dimming:

1) Class 2 / Class 1 (NOTE: Installation as Class 1 requires 600 volt insulation on dimming conductors sharing a conduit with line voltage conductors)

2.13 SOFTWARE INTERFACES

A. NX controlHUBB Mobile App

1. NX controlHUBB Mobile App shall provide Bluetooth® wireless setup and configuration of NX system devices and luminaires equipped with an NX In-Fixture Module and smart sensor.
   NX controlHUBB Mobile App shall be available in Android and iOS versions for free download from Google Play™ or Apple® App Store.
2. NX controlHUBB Mobile App shall communicate with NX Room Control devices via a NXBTR, NXBTC, or NXSMP sensor radio modules via Bluetooth BLE.
3. NX controlHUBB Mobile App shall enable easy setup and configuration of NX room devices and NX panels.
4. NX controlHUBB Mobile App shall enable users to create custom schedules and presets.
5. NX controlHUBB Mobile App shall be able to configure SpectraSync™ or SpectraClean™
6. enabled luminaires.
7. NX controlHUBB Mobile App shall globally discover wireless enabled luminaires and devices.
8. NX controlHUBB Mobile App shall include the IntelliSCOPE™ visual diagnostic tool forreal- time calibration and testing of NX digital smart sensors.

2.14 CONDUCTORS AND CABLING

A. Power Supply Side of Remote-Control Power Sources: Comply with network manufacturer's requirements and requirements of Division 26 Section "Low-Voltage Electrical Power Conductors."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, contractor shall examine work area to verify measurements, all wire type and routing requirements, and that commencing installation complies with manufacturer's requirements.

B. Where variations from the general specifications or drawings exist, the contractor shall request a clarification prior to rough in or installation

3.2 INSTALLATION

A. Lighting controls shall be installed in accordance with manufacturer's instructions, guidelines and submittal documents provided by the lighting control manufacturer.

B. Lighting control system components shall only be installed in spaces that meet the following environmental conditions:

1. Temperature: 32 – 104 deg F (0 - 40 deg C).
2. Relative Humidity: 10 – 90 percent, noncondensing.

C. All stored and installed lighting control system components shall be adequately protected from dust and dirt.

3.3 SYSTEM STARTUP

A. The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system.

B. Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field engineer required to complete the system start-up.

C. Factory field engineer shall provide a written report of test and outcomes.

3.4 DEMONSTRATION AND TRAINING

A. Factory field engineer shall instruct owner's staff on how to adjust, operate and maintain lighting systems; and provide instruction using the system software.
1. Allow for up to 4 hours of on-site training on the use and maintenance of the lighting control system to be scheduled at the completion of startup and programming of the system.

3.5 TECHNICAL SUPPORT

A. Manufacturer shall provide reasonable access to factory direct telephone technical support during normal business hours.

END OF SECTION 260923

SECTION 261219 – PAD MOUNTED, LIQUID-FILLED, MEDIUM VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of transformers with medium-voltage primaries:
   1. Pad-mounted outdoor, liquid-filled transformers.

1.3 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.4 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.

B. Shop Drawings: Diagram power wiring.

C. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

   1. Underground primary and secondary conduit stub-up location.
   2. Dimensioned concrete base, outline of transformer, and required clearances.
   3. Ground rod and grounding cable locations.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Follow-up service reports.

H. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with the following Standards:
1. IEEE Std C57.12.00™ standard – Standard for Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers. Comply with ANSI C57.12.10, ANSI C57.12.28, IEEE C57.12.70, and IEEE C57.12.80.
2. IEEE Std C57.12.28™ standard – Pad-Mounted Equipment - Enclosure Integrity.
3. IEEE Std C57.12.34™ standard – Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers (2500 kVA and Smaller) - High Voltage: 34500GrdY/19920 Volts and Below; Low-Voltage: 480 Volt 2500 kVA and Smaller.
4. IEEE Std C57.12.90™ standard – Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and IEEE Guide for Short-Circuit Testing of Distribution and Power Transformers.
5. IEEE Std C57.12.91™ standard – Guide for Loading Mineral-Oil-Immersed Transformers.
6. NEMA TR 1 – Transformers, Regulators and Reactors, Table 0-2 Audible Sound Levels for Liquid-Immersed Power Transformers.
7. NEMA 260 – Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas.
8. 10 CFR Part 431 – Department of Energy – Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule.
9. Comply with NFPA 70.
10. Comply with DOE 2016 transformer efficiency standards, as applicable to the project specific transformers.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store transformers protected from weather and so condensation will not form on or in units. Provide temporary heating according to manufacturer's written instructions.

1.7 PROJECT CONDITIONS

1. Service Conditions: IEEE C37.121, usual service conditions.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of louvers, doors, spill retention areas, and sumps. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Power Systems, LLC, an Eaton company (Basis of Design)
2. ABB.
3. Square D; Schneider Electric.
4. Or approved equal

2.2 PAD-MOUNTED, LIQUID-FILLED STEP DOWN TRANSFORMERS

A. Description: ANSI C57.12.13, ANSI C57.12.26, IEEE C57.12.00, pad-mounted, 2-winding transformers with stainless-steel tank base.

B. Rating: Size of the transformer shall be as per the single line diagram drawing.

C. Insulating Liquid: Less flammable, edible-seed-oil based, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic. Liquid shall be equal to Envirotemp FR3 FM Approved, Outdoor use.

D. Insulation Temperature Rise: 55 deg C when operated at rated kVA output in a 40 deg C ambient temperature / 75 deg c when operated at 122% of rated kVA in a 40 deg C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C without loss of service life expectancy.

E. Features:
1. Primary Voltage: 13,200V DELTA, 95 kV BIL.
2. Secondary Voltage: 480/277V WYE, 30kV BIL.
3. Secondary Bushings: Spade Terminals with CU/AL dual rated lugs
4. Configuration: Dead Front Radial Feed with 200A bushing wells.
5. Primary and secondary windings: Copper.
6. Efficiency Standard: DOE 2016, 10 CFR Part 431
7. Impedance: 5.75% +/- 0.75%, per IEEE tolerances
8. Color: Munsell green.
9. Taps 2 - 2.5% taps above and 2 - 2.5% taps below nominal. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the

tap changer as required in Section 4.3 of IEEE Std C57.12.34™-2009 standard. The tap changer shall be operable on the higher voltage only for transformers with dual voltage primaries.

10. Tap Changer 100 Amp 5-position tap changer.
11. Load-break Switching: None.
12. Overcurrent Protection Bayonet Fuses in series with Partial-Range Current-Limiting Fuses (Qty: 3)
13. Expulsion fuses Bayonet fuses (Qty: 3)
14. Bayonet Holder Copper Bayonet Fuse Holder (Qty: 3)
15. Low Voltage kV Class 1.2 kV
16. Low Voltage Bushings 5/8" copper stud with 4-hole screw-on spade bushing(s) (Qty: 4)
17. Cabinet 24 inch deep cabinet
18. Cabinet hardware Penta-head cabinet door bolts
19. Coatings Munsell Green (Munsell 7GY 3.29/1.5) topcoat
20. Construction 304L Stainless steel tank base.
21. Certifications FM Approved Nameplate (Outdoor Install)
22. Certifications UL Listed
23. External Gauges in a padlockable box:
    a. Gauges & Fittings Liquid level gauge
    b. Gauges & Fittings Thermometer, dial-type
    c. Gauges & Fittings Pressure/vacuum gauge
24. Gauges & Fittings: Schrader valve
25. Gauges & Fittings: Pressure relief device: 450 SCFM
26. Gauges & Fittings: Drain valve (1") with sampler in LV compartment
27. Tank accessories Nitrogen Blanket
28. Tank accessories IEEE standard one-hole ground pads (Qty: 3)
29. Packaging Pallet
30. Cover Bolted cover
31. Laser-scribed anodized nameplate – inside and outside.

2.3 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Perform design and routine tests according to standards specified for components. Conduct transformer tests according to IEEE C57.12.90.

B. Factory Tests: Perform the following factory-certified tests on each transformer:

1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.
2. Ratios on rated-voltage connection and on tap extreme connections.
3. Polarity and phase relation on rated-voltage connection.
4. No-load loss at rated voltage on rated-voltage connection.
5. Excitation current at rated voltage on rated-voltage connection.

6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme connections.
7. Applied potential.
8. Induced potential.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.

B. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install transformers on concrete bases or vaults, as shown on the drawings.

1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."
2. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit and 4 inches (100 mm) high.
3. Use 4000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."
4. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
5. Install epoxy-coated anchor bolts, for supported equipment, that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

B. Liquid-Filled Transformer Field Tests:

1. Preliminary testing of the transformer shall occur after delivery and prior to permanent installation in order to confirm there was no damage during shipping and rigging.

2. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect impact recorder prior to unloading.
c. Test dew point of tank gases if applicable.
d. Inspect anchorage, alignment, and grounding.
e. Verify the presence of PCB content labeling.
f. Verify removal of any shipping bracing after placement.
g. Verify the bushings are clean.
h. Verify that alarm, control, and trip settings on temperature and level indicators are set and operate within manufacturer's recommended settings.
i. Verify that cooling fans and pumps operate correctly and have appropriate overcurrent protection.
j. Verify that liquid level in tanks and bushings is within manufacturer's published tolerances.
k. Perform specific inspections and mechanical tests recommended by the manufacturer.
l. Verify presence of transformer surge arresters and that their ratings are as specified.
m. Verify that as-left tap connections are as specified.
n. Verify the presence of surge arresters and that their ratings are as specified.

3. Electrical Tests:

a. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence

of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index; the value of the index shall not be less than 1.0.

b. Perform power-factor or dissipation-factor tests on all windings according to test equipment manufacturer's published data. Maximum winding insulation power-factor/dissipation-factor values shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.3.

c. Measure core insulation resistance at 500-V dc if the core is insulated and the core ground strap is removable. Core insulation-resistance values shall not be less than 1 megohm at 500-V dc.

d. Perform a power-factor or dissipation-factor tip-up test on windings greater than 2.5 kV.

e. Perform turns-ratio tests at tap positions. Turns-ratio test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If the test fails, replace the transformer.

f. Perform an excitation-current test on each phase. The typical excitation-current test data pattern for a three-legged core transformer is two similar current readings and one lower current reading. Investigate and correct if the test shows a different pattern.

g. Measure the resistance of each winding at each tap connection, and record temperature-corrected winding-resistance values in the Operations and Maintenance Manual.

h. Perform an applied-voltage test on high- and low-voltage windings-to-ground. Comply with IEEE C57.12.91, Sections 10.2 and 10.9.

i. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

j. Remove a sample of insulating liquid according to ASTM D923. Insulating liquid values shall comply with NETA ATS, Table 100.4. Sample shall be tested for the following:

    1) Dielectric Breakdown Voltage: ASTM D877 or ASTM D1816.
    2) Acid Neutralization Number: ASTM D974.
    3) Specific Gravity: ASTM D1298.
    4) Interfacial Tension: ASTM D971.
    5) Color: ASTM D1500.
    6) Visual Condition: ASTM D1524.
    7) Water in Insulating Liquids: ASTM D1533.
    8) Power Factor or Dissipation Factor: ASTM D924.

k. Remove a sample of insulating liquid according to ASTM D923 and perform dissolved-gas analysis according to IEEE C57.104 or ASTM D3612.

C. Perform the following field tests and inspections and prepare test reports:

1. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
2. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Test Reports: Prepare written reports to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

3.6 INFRARED TESTING

A. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove covers prior to the inspection.

1. Prior to Substantial Completion, perform infrared inspection of the electrical power connections of the transformer.
2. Instrument: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1deg C at 30 deg C.
3. Record of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used and lists the results as follows:

a. Description of equipment to be tested.
b. Discrepancies.
c. Temperature difference between the area of concern and the reference area.
d. Probable cause of temperature difference.
e. Areas inspected. Identify inaccessible and unobservable areas and equipment.
f. Identify load conditions at time of inspection.
g. Provide photographs and thermograms of the deficient area.

4. Act on inspection results according to the recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.

END OF SECTION 261219

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SECTION 261300 - MEDIUM-VOLTAGE PAD MOUNTED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes outdoor pad mounted loop switch equipment with the following optional components, features, and accessories:

1. Copper, silver-plated main bus at connection points.
2. Surge arresters.
3. Provisions for future devices.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. GFCI: Ground-Fault Circuit Interrupter.

1.4 SUBMITTALS

A. Product Data: For each type of switchgear and related equipment, include the following:

1. Rated capacities, operating characteristics, furnished specialties, and accessories for individual interrupter switches.
2. Time-current characteristic curves for overcurrent protective devices, including fusible devices.

B. Shop Drawings: For each type of switchgear and related equipment, include the following:

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:

a. Tabulation of installed devices with features and ratings.
b. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
c. Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.
d. Floor plan drawing showing locations for anchor bolts and leveling channels.
e. Current ratings of buses.
f. Short-time and short-circuit ratings of switchgear assembly.

g. Nameplate legends.
h. Mimic-bus diagram.

2. Wiring Diagrams: For each type of switchgear and related equipment, include the following:

a. Power, signal, and control wiring.
b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
c. Diagrams showing connections of component devices and equipment.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where piping and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For switchgear and switchgear components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with IEEE C2.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections of lengths that can be moved past obstructions in delivery path as indicated.

B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subjected to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250 W per section) to prevent condensation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation at indicated ampere ratings for the following conditions:

1. Ambient temperature not exceeding 122 deg F (50 deg C).
2. Altitude of 500 feet above sea level.

1.8 COORDINATION

A. Coordinate layout and installation of switchgear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Three of each type and rating used. Include spares for future transformers, control power circuits, and fusible devices.

2. Touchup Paint: Three containers of paint matching enclosure finish, each 0.5 pint (250 mL).

B. Maintenance Tools: Furnish tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation. Include the following:

1. Fuse-handling tool.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
a. S&C Electric (Basis of Design).
b. Approved equal by the Engineer.

2.2 PAD MOUNTED DEAD FRONT ELBOW CONNECTED SWITCH

A. The pad-mounted gear shall be in accordance with the one-line diagram, and shall conform to the following specifications. Configuration shall be equal to the S&C electric PME-9.

B. The pad-mounted gear shall consist of a single self-supporting enclosure, containing interrupter switches and power fuses with the necessary accessory components, all completely factory-assembled and operationally checked. The interrupter switches and fuses shall be enclosed within an inner grounded steel compartment for electrical isolation and for protection from contamination. Switch terminals shall be equipped with bushings rated 600 amperes continuous, and fuse terminals and bus terminals shall be equipped with bushing wells rated 200 amperes continuous to provide for elbow connection. Bushings and bushing wells shall be mounted on the walls of the inner compartment and shall extend into termination compartments. Termination compartments shall be provided as follows: one for each three-phase switch, one for each three-phase set of fuses, and one for each three-phase set of bus terminals.

C. Ratings
1. Operating Voltage, 13.2kV
2. Nominal Voltage, 14.4 kV
3. Maximum Voltage, 17.0 kV
4. BIL Voltage, 95 kV
5. Short-Circuit
i. Peak Withstand Current, 36,400 Amperes, Peak
ii. One-Second Short-Time Withstand Current, 14,000 Amperes, RMS, Symmetrical
iii. 350 MVA, Three-Phase Symmetrical, at Rated Nominal Voltage

6. Main Bus

i. Continuous Current, 600 Amperes
ii. Peak Withstand Current, 65,000 Amperes, Peak
iii. One-Second Short-Time Withstand Current, 25,000 Amperes, RMS, Symmetrical

7. Three-Pole Interrupter Switches
   i. Continuous Current, 600 Amperes
   ii. Load Dropping Current, 600 Amperes
   iii. Peak Withstand Current, 65,000 Amperes, Peak
   iv. One-Second Short-Time Withstand Current, 14,000 Amperes, RMS, Symmetrical
   v. Three-Time Duty-Cycle Fault-Closing Current, 14,000 Amperes, RMS, Symmetrical
   vi. Three-Time Duty-Cycle Fault-Closing Current, 36,000 Amperes, Peak

8. Fuses
   i. Maximum Current, Amperes 200, 200E, or 200K

9. Terminations:
   i. 600A dead break wells and elbows on the switched terminals.
   ii. 200A load break wells and elbows on the fused terminals.

10. The short-circuit and three-time duty-cycle fault-closing ratings of switches, short-circuit rating of bus, and interrupting ratings of fuses shall equal or exceed the short-circuit ratings of the pad-mounted gear.

D. Certification of Ratings

1. The manufacturer of the pad-mounted gear shall be completely and solely responsible for the performance of the basic switch and fuse components as well as the complete integrated assembly as rated.

2. The manufacturer shall furnish, upon request, certification of ratings of the basic switch and fuse components and/or the integrated pad-mounted gear assembly consisting of the switch and fuse components in combination with the enclosure.

E. Compliance with Standards and Codes

The pad-mounted gear shall conform to or exceed the applicable requirements of the following standards and codes:

1. All portions of ANSI C 57.12.28, covering enclosure integrity for pad-mounted equipment.

2. Article 710-21(e) in the National Electrical Code, which specifies that the interrupter switches in combination with power fuses shall safely withstand the effects of closing, carrying, and interrupting all possible currents up to the assigned maximum short-circuit rating.

3. All portions of ANSI, IEEE, and NEMA standards applicable to the basic switch and fuse components.

F. Enclosure Design

1. To ensure a completely coordinated design, the pad-mounted gear shall be constructed in accordance with the minimum construction specifications of the fuse and/or switch manufacturer to provide adequate electrical clearances.

2. In establishing the requirements for the enclosure design, consideration shall be given to all relevant factors such as controlled access, tamper resistance, corrosion resistance, and resistance to entry of foliage, animals, and airborne contaminants.

2.3 CONSTRUCTION – ASSEMBLY

A. Insulators: The interrupter-switch and fuse-mounting insulators shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:

1. Operating experience of at least 15 years under similar conditions.

2. Adequate leakage distance established by test per IEC Publication 507, First Edition, 1975.

3. Adequate strength for short-circuit stress established by test.

4. Conformance with applicable ANSI standards.

5. Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation. Furthermore, any surface damage to insulators during installation or maintenance of the pad-mounted gear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.

B. High-Voltage Bus

1. Bus and interconnections shall consist of copper bar 98% conductivity.

2. Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the pad-mounted gear.

3. Bolted copper-to-copper connections shall be made with a suitable number of galvanized steel bolts and with two Belleville spring washers per bolt, one under the bolt head and one under the nut. Bolts shall be tightened to 50 foot-pounds torque.

4. Before installation of the bus, all electrical contact surfaces shall first be

prepared by machine abrading to remove any oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.

5. Tie bus, where furnished, shall consist of continuous, one-piece sections of copper bar with no intermediate splices. Flexible braid or cable shall not be used.

C. Provisions for Grounding

1. A ground-connection pad shall be provided in each termination compartment of the pad-mounted gear.

2. The ground-connection pad shall be constructed of ¼" thick steel, which shall be nickel plated and welded to the enclosure, and shall have a short-circuit rating equal to that of the pad-mounted gear.

3. Ground-connection pads shall be coated with a uniform coating of an oxide inhibitor and sealant prior to shipment.

4. A 3/8" diameter copper rod connected to the ground-connection pad shall be provided in each termination compartment for switches and each termination compartment for bus. The rod shall extend across the full width of each compartment to allow convenient grounding of cable concentric neutrals and accessories, and shall have a short-circuit rating equal to that of the pad-mounted gear.

5. Continuous copper ground bus shall be provided across the full width of each termination compartment for fuses. For each fuse mounting, there shall be a ground ring made of 3/8" diameter copper rod bolted to the ground bus and placed to allow convenient grounding of cable concentric neutrals and accessories. Ground rings and bus shall have a short-circuit rating equal to that of the pad-mounted gear.

D. Bushing and Bushing Wells

1. Bushings and bushing wells shall conform to ANSI/IEEE Standard 386 (ANSI Standard C119.2).

2. Bushings and bushing wells shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:

a. Operating experience of at least 10 years under similar conditions.

b. Adequate leakage distance for in-air application established by test per IEC Publication 507, First Edition, 1975.

c. Adequate strength for short-circuit stress established by test.

d. Conformance with applicable ANSI standards.

e. Homogeneity of the cycloaliphatic epoxy resin throughout each bushing or bushing well to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation.

3. Bushings and bushing wells shall be mounted in such a way that the semiconductive coating is solidly grounded to the enclosure.

4. Bushings rated 600 amperes continuous shall have a removable threaded stud so that the bushings are compatible with all 600-ampere elbow systems—those requiring a threaded stud as well as those that do not.

5. Bushings rated 600 amperes continuous for switch terminals and 200 amperes continuous for fused terminals.

E. Termination Compartments

1. Termination compartments for switches shall have bushings, and termination compartments for fuses shall have bushing wells to permit connection of elbows. The bushings and bushing wells shall be mounted on the interior walls at a minimum height of 33 inches above the enclosure base.

2. Termination compartments for bus shall have bushing wells to permit connection of elbows. The bushing wells shall be mounted on the interior walls at a minimum height of 25 inches above the enclosure base.

3. Termination compartments for bushings rated 200 amperes continuous shall be of an adequate depth to accommodate two 200-ampere elbows mounted piggyback, encapsulated surge arresters or grounding elbows mounted on 200-ampere elbows having 200-ampere interfaces, or other similar accessory combinations without the need for an enclosure extension.

4. Termination compartments for bushing wells rated 200 amperes continuous shall be of an adequate depth to accommodate 200-ampere elbows mounted on portable feedthrus or standoff insulators, or other similar accessory combinations without the need for an enclosure extension.

5. Termination compartments for bushings rated 600 amperes continuous shall be of an adequate depth to accommodate two 600-ampere elbows mounted piggyback, encapsulated surge arresters or grounding elbows mounted on 600-ampere elbows having 200-ampere interfaces, or other similar accessory combinations without the need for an enclosure extension.

6. Termination compartments shall be provided with one parking stand for each bushing or bushing well. The parking stand shall be located immediately adjacent to the associated bushing or bushing well and shall accom-

modate standard feedthrus and standoff insulators, and other similar accessories.

7. Each termination compartment for a switch shall be equipped with a viewing window to allow visual inspection of interrupter switch blades to allow positive verification of switch position.

8. Each termination compartment for a set of fuses shall be equipped with a set of viewing windows to allow visual inspection of blown-fuse indicators.

2.4 CONSTRUCTION – ENCLOSURE INCLUDING OUTDOOR FINISH

A. Enclosure

1. The pad-mounted gear enclosure shall be of unitized monocoque (not structural-frame-and-bolted-sheet) construction to maximize strength, minimize weight, and inhibit corrosion.

2. The basic material shall be 11-guage hot-rolled, pickled and oiled steel sheet.

3. All structural joints and butt joints shall be welded, and the external seams shall be ground flush and smooth. The gas-metal-arc welding process shall be employed to eliminate alkaline residues and to minimize distortion and spatter.

4. To guard against unauthorized or inadvertent entry, enclosure construction shall not utilize any externally accessible hardware.

5. The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.

6. The door openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between doors and door openings to guard against water entry.

7. Gasketing between the roof and the enclosure shall guard against entry of water and airborne contaminants and shall discourage tampering or insertion of foreign objects.

8. A heavy coat of insulating "no-drip" compound shall be applied to the inside surface of the roof to minimize condensation of moisture thereon.

9. An internal steel-enclosed compartment shall encase the interrupter switches and fuses for electrical isolation and protection from contamination. The compartment shall have a galvanized steel sheet floor to exclude foliage and animals. The floor shall have screened drain vents to allow drainage if the enclosure is flooded. The top of this compartment shall be gasketed to provide sealing with the enclosure roof.

10. Insulating barriers of NEMA GPO3-grade fiberglass-reinforced polyester shall be provided for each interrupter switch where required to achieve BIL ratings. Additional insulating barriers of the same material shall isolate the tie bus (where furnished).

11. Full – length steel barriers shall separate adjoining termination compartments.

12. Lifting tabs shall be removable. Sockets for the lifting-tab bolts shall be blind-tapped. A resilient material shall be placed between the lifting tabs and the enclosure to help prevent corrosion by protecting the finish against scratching by the tabs. To further preclude corrosion, this material shall be closed-cell to prevent moisture from being absorbed and held between the tabs and the enclosure in the event that lifting tabs are not removed.

13. The enclosure shall be provided with an instruction manual holder.

B. Doors

1. Doors shall be constructed of 11-guage hot-rolled, pickled and oiled steel sheet.

2. Door-edge flanges shall overlap with door-opening flanges to discourage tampering or insertion of foreign objects.

3. Doors shall have a minimum of two extruded-aluminum hinges with stainless-steel hinge pins, and interlocking extruded-aluminum hinge supports for the full length of the door to provide strength, security, and corrosion resistance. Mounting hardware shall be stainless steel or zinc-nickel-plated steel, and shall not be externally accessible to guard against tampering.

4. Doors shall be hinged at the sides to swing open with minimum effort. Doors hinged at the top requiring significant effort to lift open shall not be allowed.

5. In consideration of controlled access and tamper resistance, each door (or set of double doors) shall be equipped with an automatic three-point latching mechanism.

   a) The latching mechanism shall be spring loaded, and shall latch automatically when the door is closed. All latch points shall latch at the same time to preclude partial latching.

   b) A pentahead socket wrench or tool shall be required to actuate the mechanism to unlatch the door and, in the same motion, recharge the spring for the next closing operation.

   c) The latching mechanism shall have provisions for padlocking that incorporate a means to protect the padlock shackle from tampering and that shall be coordinated with the latches such that:

1) It shall not be possible to unlatch the mechanism until the padlock is removed, and

2) It shall not be possible to insert the padlock until the mechanism is completely latched closed.

6. Doors providing access to solid-material power fuses shall have provisions to store spare fuse units or refill units.

7. Each door shall be provided with a zinc-nickel-plated steel door holder located above the door opening. The holder shall be hidden from view when the door is closed, and it shall not be possible for the holder to swing inside the enclosure.

C. Finish

1. Full coverage at joints and blind areas shall be achieved by processing enclosures independently of components such as doors and roofs before assembly into the unitized structures.

2. All exterior seams shall be filled and sanded smooth for neat appearance.

3. To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, all surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling before any protective coatings are applied. By utilizing an automated pretreatment process, the enclosure shall receive a highly consistent thorough treatment, eliminating fluctuations in reaction time, reaction temperature, and chemical concentrations.

4. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the steel enclosure. To establish the capability to resist corrosion and protect the enclosure, representative test specimens coated by the enclosure manufacturer's finishing system shall satisfactorily pass the following tests:

a) 4000 hours of exposure to salt-spray testing per ASTM B 117 with:

(1) Underfilm corrosion not to extend more than 1/32” from the scribe as evaluated per ASTM D 1645, Procedure A, Method 2 (scraping); and

(2) Loss of adhesion from bare metal not to extend more than 1/8” from the scribe.

b) 1000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet with no blistering as evaluated per ASTM D 714.

c) 500 hours of 500 hours of accelerated weathering testing per ASTM G 53 using lamp UVB-313 with no chalking as evaluated per ASTM D 659, and no more than 10% reduction of gloss as evaluated per ASTM D 523.

d) Crosshatch adhesion testing per ASTM D 3359 Method B with no loss of finish.

e) 160-inch-pound impact adhesion testing per ASTM D 2794 with no chipping or cracking.

f) Oil resistance testing consisting of a 72-hour immersion bath in mineral oil with no shift in color, no streaking, no blistering, and no loss of hardness.

g) 3000 cycles of abrasion testing per ASTM 4060 with no penetration to the substrate.

Certified test abstracts substantiating the above capabilities shall be furnished upon request.

5. After the finishing system has been properly applied and cured, welds along the enclosure bottom flange shall be coated with a wax-based anti-corrosion moisture barrier to give these areas added corrosion resistance.

6. A resilient closed-cell material, such as PVC gasket, shall be applied to the entire underside of the enclosure bottom flange to protect the finish on this surface from scratching during handling and installation. This material shall isolate the bottom flange from the alkalinity of a concrete foundation to help protect against corrosive attack.

7. After the enclosure is completely assembled and the components (switches, fuses, bus, etc.) are installed, the finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish.

8. The finish shall be olive green, Munsell 7GY3.29/1.5.

D. To guard against corrosion, all hardware (including door fittings, fasteners, etc.), all operating-mechanism parts, and other parts subject to abrasive action from mechanical motion shall be of either nonferrous materials, or galvanized or zinc-nickel-plated ferrous materials. Cadmium-plated ferrous parts shall not be used.

2.5 BASIC COMPONENTS

A. Interrupter Switches

1. Interrupter switches shall be enclosed in an inner steel compartment and shall be provided with bushings rated 600 amperes continuous to permit connection of elbows external to the switch compartment.

2. Interrupter switches shall have a two-time duty-cycle fault-closing rating equal to or exceeding the short-circuit rating of the pad-mounted gear. These ratings define the ability to close the interrupter switch twice against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum voltage with current applied for at least 10 cycles. Certified test abstracts establishing such ratings shall be furnished upon request.

3. Interrupter switches shall be operated by means of an externally accessible 3/4" hex switch-operating hub. The switch-operating hub shall be located within a recessed stainless-steel pocket mounted on the side of the pad-mounted gear enclosure and shall accommodate a 3/4" deep-socket wrench or a 3/4" shallow-socket wrench with extension. The switch-operating-hub pocket shall include a padlockable stainless-steel access cover that shall incorporate a hood to protect the padlock shackle from tampering. Stops shall be provided on the switch-operating hub to prevent overtravel and thereby guard against damage to the interrupter switch quick-make quick-break mechanism. Labels to indicate switch position shall be provided in the switch-operating-hub pocket.

4. Each interrupter switch shall be provided with a folding switch-operating handle. The switch-operating handle shall be secured to the inside of the switch-operating-hub pocket by a brass chain. The folded handle shall be stored behind the closed switch-operating-hub access cover.

5. Interrupter switches shall utilize a quick-make quick-break mechanism installed by the switch manufacturer. The quick-make quick-break mechanism shall be integrally mounted on the switch frame, and shall swiftly and positively open and close the interrupter switch independent of the switch-operating-hub speed.

6. Each interrupter switch shall be completely assembled and adjusted by the switch manufacturer on a single rigid mounting frame. The frame shall be of welded steel construction such that the frame intercepts the leakage path which parallels the open gap of the interrupter switch to positively isolate the load circuit when the interrupter switch is in the open position.

7. Interrupter switch contacts shall be backed up by stainless-steel springs to provide constant high contact pressure.

8. Interrupter switches shall be provided with a single blade per phase for circuit closing including fault closing, continuous current carrying, and circuit interrupting. Spring-loaded auxiliary blades shall not be permitted. Interrupter switch blade supports shall be permanently molded in place in a unified insulated shaft constructed of the same cycloaliphatic epoxy resin as the insulators.

9. Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence. Circuit inter-

ruption shall take place completely within the interrupter, with no external arc or flame. Any exhaust shall be vented in a controlled manner through a deionizing vent.

11. Key interlocks shall be provided to guard against opening the door(s) of fuse-termination compartment(s) unless all switches are locked open.

12. Mounting provisions shall be provided to accommodate one three-phase fault indicator with three single-phase sensors in each switch-termination compartment.

    a) Provide (3) fault indicators per compartment and viewing window for viewing through closed door.

13. Interrupter switch bushings rated 600 amperes continuous shall be provided without studs.

B. Fuses

1. Solid-Material Power Fuses

a) Fuses shall be solid-material power fuses, and shall utilize refill-unit-and-holder or fuse-unit-and-end-fitting construction. The refill unit or fuse unit shall be readily replaceable and low in cost.

b) Fusible elements shall be nonaging and nondamageable so that it is unnecessary to replace unblown companion fuses on suspicion of damage foll owing a fuse operation.

c) Fusible elements for refill units or fuse units rated 10 amperes or larger shall be helically coiled to avoid mechanical damage due to stresses from current surges.

d) Fusible elements, that carry continuous current, shall be supported in air to help prevent damage from current surges.

e) Each refill unit or fuse unit shall have a single fusible element to eliminate the possibility of unequal current sharing in parallel current paths.

f) Solid-material power fuses shall have melting time-current characteristics that are permanently accurate to within a maximum total tolerance of 10% in terms of current. Time-current characteristics shall be available which permit coordination with protective relays, automatic circuit reclosers, and other fuses.

g) Solid-material power fuses shall be capable of detecting and interrupting all faults whether large, medium, or small (down to minimum melting current), under all realistic conditions of circuitry, with line-to-line or line-to-ground voltage across the fuse, and shall be capable of handling the full range of transient recovery voltage severity associated with these faults.

h) All arcing accompanying operation of solid-material power fuses shall be contained within the fuse, and all arc products and gases evolved shall be effectively contained within the exhaust control device during fuse operation.

i) Solid-material power fuses shall be equipped with a blown-fuse indicator that shall provide visible evidence of fuse operation while installed in the fuse mounting.

2. Fuse mountings shall be enclosed in an inner steel compartment and shall be provided with bushing wells rated 200 amperes continuous for elbow connection.

a) Each fuse mounting shall be an integral part of a fuse handling mechanism that does not allow access to the fuse until the elbow for that fuse has been disconnected. To gain access to a fuse it shall be necessary to:

(1) Disconnect the elbow for that fuse and move it to the appropriate parking stand.

(2) Actuate a mechanical interlock to unlock the fuse-access panel. It must not be possible to disengage this interlock before the elbow is moved.

(3) Unlatch and then pivot the fuse-access panel to electrically isolate the fuse so that it can be removed from the fuse mounting with a shotgun stick.

b) The opening into the component compartment shall be covered by the fuse-access panel in both the open and closed positions to help prevent inadvertent access to high voltage.

c) To protect the fuse-handling mechanism from corrosion, all mechanism parts shall be painted or made of corrosion-resistant materials, or otherwise be protected from corrosion. All latches and pivots shall be stainless steel or zinc-nickel-plated steel with nylon or plastic bushings.

d) Cable guides shall be provided in each termination compartment for a set of fuses, to prevent cables from interfering with rotation of the fuse-access panel.

2.6 LABELING

A. Hazard-Alerting Signs

1. All external doors shall be provided with "Warning—Keep Out—Hazardous Voltage Inside—Can Shock, Burn, or Cause Death" signs.

2. The inside of each door shall be provided with a "Danger—Hazardous Voltage—Failure to Follow These Instructions Will Likely Cause Shock, Burns, or Death" sign. The text shall further indicate that operating personnel must know and obey the employer's work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment.

3. Termination compartments shall be provided with "Danger—Keep Away—Hazardous Voltage—Will Shock, Burn, or Cause Death" signs.

B. Nameplates, Ratings Labels, and Connection Diagrams

1. The outside of each door (or set of double doors) shall be provided with a nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture, and serial number.

2. The inside of each door (or set of double doors) shall be provided with a ratings label indicating the following: voltage ratings; main bus continuous rating; short-circuit ratings (amperes rms symmetrical and Mva three-phase symmetrical at rated nominal voltage); the type of fuse and its maximum ampere rating; and interrupter switch ratings including duty-cycle fault-closing and short-time (momentary, amperes rms asymmetrical and one-second, amperes rms symmetrical).

3. A three-line connection diagram showing interrupter switches, fuses, and bus along with the manufacturer's model number shall be provided on the inside of each door (or set of double doors), and on the inside of each switch-operating-hub access cover.

2.7 ACCESSORIES

A. End fittings or holders, and fuse units, refill units, or interrupting modules and control modules for original installation, as well as one spare fuse unit, refill unit, or interrupting module for each fuse mounting shall be furnished.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive switchgear for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Anchor switchgear assembly to concrete slab as per manufacturer’s installation instructions.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Diagram and Instructions:

1. Frame under clear acrylic plastic on switchgear doors.

    a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
    b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.

2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

3.4 CONNECTIONS

A. Cable terminations at switchgear are specified in Division 26 Section "Medium-Voltage Cables."

B. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables" and "Medium-Voltage Cables."

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect switchgear, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
2. Assist in field testing of equipment including pretesting and adjusting.
3. Report results in writing.

C. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:

a. Switchgear.

E. Remove and replace malfunctioning units and retest as specified above.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of switchgear. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 261300

SECTION 262200 – ULTRA-HIGH EFFICIENCY LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

a. Ultra-High Efficient Transformers

1.3 DEFINITIONS

A. Linear Load: A load (i.e., a motor, incandescent lamp, resistor) that does not influence the shape of the original sinusoidal current waveform but may change the relative timing (phase angle) between the sinusoidal voltage and current waveform.

B. Nonlinear Load: A load (i.e. rectifier, arc, motor drive, switch-mode power supply, fluorescent lamp) that influences the shape of the current waveform resulting in a condition in which total harmonic distortion of current (THD_I) is greater than total harmonic distortion of voltage (THD_V). Because the current supplying a nonlinear load is interrupted by a switching action, the current contains frequency components (harmonics) that are multiples of the fundamental frequency.

C. Total Harmonic Distortion of Current (THDi): A measure of the harmonic current distortion present in a system or sub-system defined as the ratio of the sum of all harmonic current frequency components to the fundamental current frequency component.

D. Total Harmonic Distortion of Voltage (THDv): A measure of the harmonic voltage distortion present in a system or sub-system defined as the ratio of the sum of all harmonic voltage frequency components to the fundamental voltage frequency component.

1.4 ACTION SUBMITTALS

A. Product Data: Submit the following information for review and approval by the engineer of record prior to delivery and installation of each transformer that is to be supplied for this project.

1. Nameplate kVA rating.

2. Nominal Voltage rating, primary and secondary.
3. Winding configuration, primary and secondary.
4. Core and coil materials.
5. Taps, quantity and configuration.
6. Dimensions.
7. Weight.
8. Accessories.
9. Performance Characteristics:
    a. Frequency.
    b. Impedance.
    c. Insulation class.
    d. Temperature rise.
    e. Sound level.
    f. BIL rating.
    g. Inrush data.
    h. Accessories.
    i. Loss and efficiency data.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Transformer manufacturers proposing to submit a bid for ultra efficient transformers shall have a minimum of fifteen years' experience in the design and manufacture of ultra efficient transformers. Manufacturing experience in the design and manufacture of general purpose transformers does not qualify.
2. Manufacturer shall be ISO 9001 certified.

B. Source Limitations: Obtain each transformer type through one source from a single manufacturer. Pricing for transformers must be provided separate from other distribution system equipment and must be clearly listed on the bid form based on manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.9 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer warrants that the product(s) delivered conforms to the specifications and is free from defects in material and workmanship for the Warranty Period(s) indicated below, pro-rated from the date of Substantial Completion, provided that the product(s) have not been misused, abused, altered, neglected, improperly installed or damaged.

B. Warranty Period: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Terms and Conditions

a. General Purpose - Ultra Efficient Transformers: Twenty (20) years pro-rated, with standard limited liability clauses provided that the manufacturer participates in and approves of the product application indicated on the Construction Drawings.

C. Limit of Liability:

1. Manufacturer's overall liability is limited to the cost of the product or defective part.

PART 2 - PRODUCTS

2.1 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores:

1. Three-phase, common core construction with one leg per phase.
2. Grain-oriented, non-aging silicon steel.
3. Anti-vibration pads shall be installed between the core and the enclosure.
4. All transformers112.5 kVA and above shall utilize a miter-cut core to achieve ultra-low, no-load losses and the core shall be constructed with no more than three laminations per vertical or horizontal group.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed type.
2. Coil Material: Copper.

D. Voltage Class: 1.2 kV.

E. BIL Rating: 10 kV

F. Magnetic Field: 0.1 Gauss at a maximum of 18 inches.

G. Losses and Efficiency:

1. Linear load losses and efficiency:

a. Linear losses and efficiency shall be determined in accordance with U.S. Department of Energy (DOE) Code of Federal Regulations (CFR) requirements as defined in Energy, 10 CFR. §431, Subpart K, Appendix A (2015) using the ″Open Circuit and Short Circuit Test Method". Manufacturers shall provide proof of compliance Type Tests for each transformer type and kVA rating. Type Tests are required with each submission.

b. Linear loss curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating. Linear losses at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent and 100 percent of full load shall be easily identified on each transformer loss curve AND shall be identified separately in table or other form to the nearest thousandth of a kilowatt (kW).

c. Linear efficiency curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating. Linear efficiency ratings at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent, and 100 percent of full load shall be easily identified on each transformer efficiency curve and shall be identified separately in table or other form to the nearest one hundredth of one percent.

2. Nonlinear load losses and efficiency:

a. Currently, there are no recognized standards for "measuring" transformer losses and determining transformer efficiencies under nonlinear load conditions. Therefore, nonlinear losses and efficiencies must be calculated in accordance with IEEE Std. C57.110-2004, "IEEE Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents". Manufacturers shall provide proof of compliance calculations for each transformer type and kVA rating. Calculations are required with each submission.

1) IEEE Std. C57.110-2004 enables any transformer manufacturer to utilize the known linear losses and efficiencies of their transformers, which must be obtained using the "Open Circuit and Short Circuit Test Method", defined in Energy, 10 CFR. §431, Subpart K, Appendix A (2015), to calculate the nonlinear losses and efficiencies of those same transformers under any "specific" nonlinear load condition. For the purposes of this specification, a "specific" nonlinear load condition shall be characterized by the transformer's load level (as a percentage of nameplate kVA rating), load K-Factor and FHL (Harmonic Loss Factor), load harmonic spectrum including harmonic magnitudes and load %THDi.

2) Nonlinear load testing programs that incorporate the use of capacitors, inductors, resistors, rectifiers, switch-mode power supplies or other electronic loads in an effort to simulate perceived, real world nonlinear load conditions in a controlled manufacturing environment are not acceptable since (i.) these testing programs are unique to each manufacturer, (ii.) non-duplicable due to source impedance variations at each manufacturer's facility and (iii.) highly inaccurate due to significant and unavoidable loss measurement and calculated efficiency errors that exist when using the "Power-In - Power-Out Method". As documented by ANSI/IEEE, when using the "Power-In - Power-Out Method" to determine input and output power characteristics, the loss measurement error may exceed plus or minus 51.6 percent and calculated efficiency error may exceed plus or minus 1.34 percent, even when using synchronized, revenue class CTs, VTs and Wattmeters.

3) Additionally, nonlinear load testing programs receive no professional, technical or governmental oversight since there are no recognized nonlinear testing standards that can be used for reference. This inevitably gives manufacturers the liberty to develop their own unique testing protocols which cannot be compared and evaluated equally against other manufacturers' who may have completely different testing protocols.

b. Nonlinear loss curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating based on a "specific" nonlinear load

condition characterized by having a 35% of nameplate kVA load, UL 1561 load K-Factor of K13, load harmonic spectrum equal to [1st-1.0, 3rd-0.150, 5th-0.320, 7th-0.250, 9th-0.080, 11th-0.150, 13th-0.125, 15th-0.040] and %THDi of 48.32%. Nonlinear losses at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent and 100 percent of full load shall be easily identified on each transformer loss curve AND shall be identified separately in table or other form to the nearest thousandth of a kilowatt (kW).

c. Nonlinear efficiency curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating based on the same "specific" nonlinear load condition used to calculate nonlinear losses (refer paragraph b. above). Nonlinear efficiency ratings at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent and 100 percent of full load shall be easily identified on each transformer efficiency curve AND shall be identified separately in table or other form to the nearest one hundredth of one percent.

2.2 DISTRIBUTION TRANSFORMERS

A. General Purpose, Isolation Transformers for Medium K-Factor Loads (K-Factor Greater Than 4.0 and Less Than or Equal to 13.0 and THDi Less Than or Equal to 40 percent):

1. Basis-of-Design Product: Subject to compliance with requirements, provide transformer equal to Power Quality International LLC, Type EY (Z3+), with 14.2% lower losses than required by Energy, CFR 10 §431.196(a)(2) (2015) or comparable product by one of the following. Just because a manufacturer is listed below does not absolve them from meeting or exceeding the requirements of all the specification requirements listed herein.

   a. PQI (Basis of Design)
   b. PowerSmiths
   c. Schneider Electric
   d. ABB / General Electric
   e. Eaton Electrical
   f. Or approved equal

   g. General purpose transformer shall be fabricated according to the following:

   h. CAN/CSA Std. C9-M1981.
   i. CAN/CSA Std. C22.2 No. 47-M90.
   j. CAN/CSA Std. C802.2.
   k. ANSI C57.110.
   l. NEMA ST-20.

2. Description:

   a. Single input, single output as indicated on the Drawings.

   b. Energy Efficiency: Low voltage, dry-type, general purpose, distribution transformers shall be ultra-efficient (Z3+) as indicated on Drawings and therefore must meet or exceed all of the following loss and energy efficiency requirements:

      1) Ultra-Efficient (Z3+), greater than DOE CSL 3 and less than DOE CSL 4:

a) 14.2% lower losses than Energy, CFR 10 §431.196(a)(2) (2015) under 35 percent linear load conditions
b) Maximum losses and minimum efficiency under linear load conditions per Table 1 - Z3+ Linear, Ultra Efficient.

Table 1 - Z3+ Linear, Ultra Efficient
Max and Min Values for Losses and Efficiency for "Ultra Efficient" Transformers Exceeding Energy, CFR 10 §431.196(a)(2) (2015) Efficiency Levels Under Linear Loading

kVA Rating	No Load		35% Load		Full Load	
	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)
15	0.047	0.00	0.094	98.25	0.428	97.22
30	0.079	0.00	0.158	98.52	0.723	97.65
45	0.107	0.00	0.214	98.66	0.980	97.87
75	0.157	0.00	0.313	98.82	1.436	98.12
112.5	0.213	0.00	0.426	98.93	1.951	98.30
150	0.262	0.00	0.525	99.01	2.405	98.42
225	0.358	0.00	0.715	99.10	3.277	98.56
300	0.445	0.00	0.889	99.16	4.075	98.66
500	0.652	0.00	1.305	99.26	5.977	98.82
750	0.885	0.00	1.771	99.33	8.112	98.93
1000	1.092	0.00	2.184	99.38	10.004	99.01

c) Nonlinear losses and efficiency shall be based on the following:
   i. UL 1561 load K-Factor: K13
   ii. Harmonic Spectrum:
   1st (1.0), 3rd (0.150), 5th (0.320), 7th (0.250), 9th (0.080), 11th (0.150), 13th (0.125), 15th (0.040).
   iii. THDi: 48.32%
d) Maximum losses and minimum efficiency per Table 2 - Z3+ Nonlinear, Ultra-Efficient, based on the nonlinear load conditions stated in paragraphs c) i., ii. and iii. above.

Table 2 - Z3+ Nonlinear, Ultra-Efficient
Max and Min Values for Losses and Efficiency for High Efficiency Transformers
Under K13 Nonlinear Loading [THDi: 48.32% , Harmonic Spectrum: 1st (1.0), 3rd (0.150), 5th (0.320), 7th (0.250), 9th (0.080), 11th (0.150), 13th (0.125), 15th (0.040)]

kVA	No Load		35% Load		Full Load	
	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)
15	0.047	0.00	0.104	98.07	0.575	96.31

Table 2 - Z3+ Nonlinear, Ultra-Efficient Max and Min Values for Losses and Efficiency for High Efficiency Transformers Under K13 Nonlinear Loading [THDi: 48.32% , Harmonic Spectrum: 1st (1.0), 3rd (0.150), 5th (0.320), 7th (0.250), 9th (0.080), 11th (0.150), 13th (0.125), 15th (0.040)]						
kVA	No Load		35% Load		Full Load	
	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)
30	0.079	0.00	0.179	98.32	1.034	96.67
45	0.107	0.00	0.248	98.45	1.475	96.83
75	0.157	0.00	0.365	98.63	2.193	97.16
112.5	0.213	0.00	0.506	98.73	3.110	97.31
150	0.262	0.00	0.627	98.82	3.887	97.47
225	0.358	0.00	0.861	98.92	5.393	97.66
300	0.445	0.00	1.108	98.96	7.252	97.64
500	0.652	0.00	1.643	99.07	10.904	97.87

c. Configuration:

1) kVA Rating: As indicated on drawings.
2) Primary Voltage: 480 V.
3) Secondary Voltage: 208/120 V.
4) System Frequency: 60 Hz.
5) Primary winding configuration shall be “Delta”. "Wye" connected primary windings shall NOT be used.
6) Primary to Secondary Phase Shift: Minus 30 degrees.
7) Positive and negative sequence impedance at 60 Hz shall be 3 percent to 6 percent.
8) Neutral connection shall be rated at two times the ampacity of the secondary phase current.
9) K-Factor Rating:

   a) Increased K-Factor Rating: Transformers shall be K13 rated and must comply with UL 1561 for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
   b) Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
   c) Indicate value of K-factor on transformer nameplate.

B. List and label as complying with UL 1561.

C. Enclosure: Ventilated, NEMA 250, Type 1, Indoor (Standard) with unless otherwise indicated on Drawings. Transformers shall be furnished without drip shields to minimize width and depth.

1. The front and back covers of the enclosure shall be securely fastened using zinc plated, hexavalent chromium free, captive stainless-steel inserts and hex-head bolts. The use of self-tapping screws to secure the front and back covers is not permitted.

D. Transformer Enclosure (Maximum) Dimensions

1. 225 kVA: 40”W x 32”D x (No Limit)”H
2. 112.5 kVA: 31” x 22” x (No Limit)”H
3. 75 kVA: 31” x 22” x 32”H

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: ANSI 61 Gray.

F. Taps for Transformers 15 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature unless otherwise indicated on Drawings.

H. Wall Brackets: Manufacturer's standard wall mounting brackets shall be provided where indicated on Drawings.

I. Low-Sound-Level Requirements:

L. Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:

a. 9 kVA and Less: 37 dBA
b. 30 to 50 kVA: 42 dBA
c. 51 to 150 kVA: 47 dBA
d. 151 to 300 kVA: 50 dBA
e. 301 to 500 kVA: 52 dBA
f. 501 to 750 kVA: 57 dBA
g. 751 to 1000 kVA: 59 dBA

2.3 IDENTIFICATION DEVICES

A. Manufacturer’s Nameplates: Nameplates (minimum of two required) for each distribution transformer shall be permanently affixed to the left and right side of each transformer enclosure so that the transformer remains permanently identified when front or back covers are removed. The placement of a single manufacturer nameplate on the front cover of the enclosure is unacceptable.

B. Identification Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer shall be used to identify the transformer name, kVA rating, source name, load name and feeder size for both primary and secondary. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.4 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

B. Construct concrete bases and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

C. Provide transformers with vibration isolation neoprene pads at each corner of the transformer. The pads should be equal to Regupol Vibration 200, or approved equal by CDM, Getzner to create a system with an approximate natural frequency of 10 Hz.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Raceway connections to the transformer shall be connected with a minimum of 36” of flexible metallic raceway to avoid transmissions of vibrations.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary General Conditions of the Specification Sections, apply to this Section.

B. The requirements of all other sections of Division 26 apply to this section.

1.2 SUMMARY

A. The Contractor shall furnish and install, where indicated, a free-standing, dead-front type low voltage distribution switchboard, utilizing group mounted circuit protective devices as specified herein, and as shown on the contract drawings.

B. The maximum size of the switchboard shall be as shown on the drawings in order to fit in the existing space and to comply with NEC required clearances.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Product data for each product and component specified.

C. Shop drawings for switchboards including dimensioned plans and elevations, component and device lists, and a single-line diagram showing main and branch bus current ratings and short-time and short-circuit ratings of switchboard.

D. Schedule of features, characteristics, ratings, and factory settings of individual protective devices.

E. Report of field tests and observations certified by the testing organization.

F. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual specified in Division 01.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide switchboard assemblies that are listed and labeled.

1. The terms "listed" and "labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. ANSI/NFPA 70 - National Electrical Code (NEC).
C. ANSI/IEEE C12.16 - Solid-State Electricity Metering.

D. ANSI C57.13 - Instrument Transformers.
E. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
F. NEMA PB 2 - Deadfront Distribution Switchboards, File E8681
G. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
H. NEMA PB 2.2 - Application Guide for Ground Fault Protective Devices for Equipment.
I. UL 50 - Cabinets and Boxes.
J. UL 98 - Enclosed and Dead Front Switches.
K. UL 489 - Molded Case Circuit Breakers.
L. UL 891 - Dead-Front Switchboards.
M. UL 943 - Standard for Ground Fault Circuit Interrupters.
N. UL 1008
O. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service.

P. Product Selection for Restricted Space: The Drawings indicate maximum dimensions for switchboard equipment including clearances between switchboard and adjacent surfaces and items. Switchboards having equal performance characteristics and complying with indicated maximum dimensions may be considered.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store so condensation will not occur on or in switchboards. Provide temporary heaters as required to assure avoiding condensation.

B. Handle switchboards in accordance with NEMA Standard PB2.1, "General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards." Use factory-installed lifting provisions.

1.6 EXTRA MATERIALS

A. Spare Fuses: Six spares of each type and rating of fuse and fusible devices used. Include spares for:

1. Fuses for fusible switches.

B. Touch-Up Paint: Three half-pint containers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Square D (Basis of Design)
2. Eaton / Cutler-Hammer products
3. General Electric.
4. Or approved equal
5. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety, including the

maximum dimensions and lead-time.

2.2 SWITCHBOARDS, GENERAL

A. The components of the switchboards shall be designed to fit in the spaces, and to accommodate the connection of all the feeders.

B. Description: Front-connected, front-accessible, with panel-mounted main device, panel-mounted branches, and sections rear aligned.

1. Main Devices: Individually fixed mounted.
2. Branch Devices: Group mounted.

2.3 FABRICATION AND FEATURES

A. Enclosure Finish for Indoor Units: Manufacture standard gray finish over a rust inhibiting primer on phosphatizing treated metal surface. Provide painted surfaces that conform to IEEE C37.20.1, "Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear," paragraph 5.2.8.

B. Pull Box on Top of Switchboard: Provide where required by installation conditions, and include the following features:

1. Adequate ventilation to maintain air temperature in pull box within same limits as switchboard.
2. Removable covers forming top, front, and sides. Top covers at rear easily removable for drilling and cutting.
3. Bottom of insulating, fire-resistant material with separate holes for cable drops into switchboards.
4. Cable supports arranged to facilitate cabling, and adequate to support cables indicated including those for future installation.

C. Buses and Connections: Three-phase, four-wire except as otherwise indicated. Features as follows:

1. Phase and Neutral Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
2. At load terminals of feeder breakers, provide silver-plated copper bus extensions equipped with pressure terminal connectors for outgoing circuit conductors.
3. Ground Bus: Per manufacturer standard for the switchboard rating using 1/4-inch by 2-inch minimum size, hard-drawn copper of 98 percent conductivity, and equipped with pressure connector terminations for feeder- and branch-circuit ground conductors. For busway feeders extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
4. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.
5. Contact Surfaces of Buses: Silver plated.
6. Main Phase Buses, Neutral Bus, and Equipment Ground Bus: Uniform capacity the entire length of the switchboard main and distribution sections. Provide for future extensions from either end by means of bolt holes or other approved method and connecting links.
7. Neutral Buses: 100 percent of the ampacity of the phase buses except as indicated and equipped with approved pressure connector terminations for outgoing circuit neutral cables. Provide braced neutral bus extensions for busway feeders with neutral

conductors.

2.4 OVERCURRENT PROTECTIVE DEVICES (OCPDs)

A. General: Provide OCPDs in indicated types, as integral components of switchboards.

B. Circuit Breakers: Except as otherwise indicated, provide circuit breakers and ancillary components, of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard design, materials, components, and construction in accordance with published product information, and as required for a complete installation.

1. Molded-Case Circuit Breakers: Provide factory-assembled, molded-case circuit breakers of frame and trip sizes, and ratings including RMS symmetrical interrupting ratings indicated. Provide breakers with permanent thermal and instantaneous magnetic trips in each pole. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Provide push-to-trip button on enclosure cover for mechanically tripping circuit breakers. Construct breakers for mounting and operating in a physical position and operating in an ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.
2. Molded case feeder circuit breakers shall be fast acting and shall provide series fault current protection for the lighting and power panelboards and associated circuit breakers.

C. Future Devices: Where provision for future overcurrent protective devices or space is indicated, equip compartments with mounting brackets, supports, bus connections, and necessary appurtenances, designed for the OCPD types and ampere ratings indicated for future installation of devices.

D. Overcurrent Protective Devices (OCPDs): Provide type, rating and features as indicated. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.

2.5 EQUIPMENT AND RATINGS

A. Indoor Main Distribution Switchboard: Shall be equal to Square D type QED-2, front accessible group mounted Switchboard, rear aligned, 480/277 Volt, 3 phase 4 wire and ground, with a continuous rating as shown on drawings, and shall be rated a minimum of 65,000 Ampere RMS Symmetrical at 480 Volts.

1. Main breakers:
   a. Equal to Schneider Electric MTZ1 low-voltage, fixed power circuit breakers with Micrologic 6.0A trip units with LSIG and ERMS functions.
   b. Breaker frame and trip ratings, as shown on the drawings.

2. Group Mounted Circuit Breakers:

   a. Circuit breakers shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
   b. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

c. Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.
d. Line-side circuit breaker connections are to be jaw type.
e. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
f. Thermal magnetic molded case, except where indicated as LSI or LSIG shall have an electronic trip mechanism equal to Square D Micrologic 5.X and 6.X trip units.
g. Where not labeled with "LSI" on the drawings, provide Square D molded case circuit breakers with fixed thermal magnetic trip settings to match the drawings.
h. Where noted with "LSIG" under a breaker tag on the drawings, provide static trip breakers with trip units equal to Square D Micrologic 6.0A series trip units.
i. Any breakers 1200A or larger shall have an ERMS function along with a blue light for indication.

B. Metering
1. On the incoming main section, provide meter equal to Square D PM8240 meter with remote color display and Ethernet jack for integral web-server function. Owner will provide IP address for meter.

C. Metering Transformers
1. All instrument transformers shall be UL recognized per Classification XODW2.
2. Current Transformers: ANSI C57.13; 5 ampere secondary, window type, with single secondary winding, primary/secondary ratio as shown on drawings, burden and accuracy consistent with connected metering and relay devices, 60 Hz.
3. Voltage Transformers: ANSI C57.13; 120 V single secondary, primary/secondary ratio as indicated, burden and accuracy consistent with connected metering and relay devices, 60 Hz.

D. Surge Protective Device (SPD):
1. Surge Protection Device shall be rated 277/480 Volt, 3 phase, 4 wire, filtered, and UL 1449 latest / 5th edition listed. It shall be integrally bus mounted in the service entrance equipment to minimize the connecting wire lengths.
2. Rating: 240kA.
3. Location: Provide one on the incoming source.

2.6 IDENTIFICATION

A. General: Identify units, devices, controls, and wiring with factory-applied labels and signs.

B. Compartment Nameplates: Engraved laminated plastic or metal nameplate for each compartment, mounted with corrosion-resistant screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install switchboards and accessory items in accordance with manufacturers' written installation instructions and the following specifications:

B. Anchor each switchboard assembly to two 4-inch-minimum channel-iron sills arranged in accordance with manufacturer's recommendations. Attach by tack welding or bolting. Level and grout sills flush with switchboard mounting surface.

3.2 GROUNDING

A. Connections: Tighten connections to comply with tightening torques specified in UL 486A and 486B.

B. Provide minimum 5-ohm ground resistance at switchboard location.

3.3 CONNECTIONS

A. Tighten switchboard bus joint bolts and electrical connector and terminal bolts in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization to perform quality control electrical testing and calibration, visual and mechanical inspections, and tests of overcurrent protective devices switchboards.

B. Pretesting: Upon completing installation of the system, perform the following preparations for tests:

1. Make insulation resistance tests of switchboard buses, components, and connecting supply, feeder, and control circuits.
2. Make continuity tests of circuits.
3. Provide manufacturer's instructions for installation and testing of switchboard to test organization.

C. Visual and Mechanical Inspections: Include the following inspections and related work:

1. Inspect for defects and physical damage, testing laboratory, labels, and nameplate compliance with up-to-date circuit connections.
2. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check switchboard anchorage, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
5. Clean switchboard interior and exterior using manufacturer's approved methods and materials.
6. Set adjustable trip breakers as per the coordination study.

3.5 CLEANING

A. Upon completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.6 DEMONISTRATION & TRAINING

A. Provide Owner with at least 2 hours of on-site training in the operation and maintenance of the equipment specified in this section.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. Requirements specified in all other sections of Division 26 apply to this Section.

1.2 SUMMARY:

A. Extent of panelboard, load-center and enclosure work, including cabinets and cutout boxes, is indicated by drawings and schedules, and as specified herein.

B. Types of panelboards and enclosures required for the project include the following:

1. Power-distribution panelboards.
2. Lighting and appliance panelboards.

C. Refer to other Division-26 sections for wires/cables, electrical boxes and fittings, and raceway work required in conjunction with installation of panelboards and enclosures.

D. Wires/cables, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards and enclosures are specified in other Division-26 sections.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's data on panelboards and enclosures.

B. Wiring Diagrams: Submit wiring diagrams for panelboards showing connections to electrical power feeders and distribution branches.

1.4 QUALITY ASSURANCE:

A. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects utilizing panelboards similar to those required for this project.

B. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 384 as applicable to installation, and construction of electrical panelboards and enclosures.
2. UL Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards," and UL's 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and labeled.
3. Special-Use Markings: Provide panelboards, constructed for special-use, with

appropriate UL markings which indicate that they are suitable for special type of use/application.

4. NEMA Compliance: Comply with NEMA Stds Pub/No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)," Pub/No. PB 1, "Panelboards," and Pub/No. PB 1.1,"Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

C. Federal Specification Compliance: Comply with FS W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

1.5 SEQUENCING AND SCHEDULING:

A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide panelboard products manufactured by:

1. Square D Co.
2. General Electric Co.
3. Cutler- Hammer / Eaton Electrical
4. Or approved equal

2.2 PANELBOARDS:

A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

B. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section "Overcurrent Protective Devices," with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.

C. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

D. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

E. Feed-Through Lugs: Sized to accommodate feeders indicated.

F. Double-Main Lugs: Sized to accommodate feeders indicated. Provide custom sizes separate from the integral main circuit breakers with internal factory wiring from the double main lugs to the integral main circuit breaker.

G. Special Features: Provide the following features for panelboards as indicated.

1. Split Bus: Vertical bus of indicated panels divided into two vertical sections with connections as indicated. Provide split bus panels for Normal -Emergency Loads, where indicated.
2. Contactors in Panels: Mechanically held, with current rating, poles, and connections as indicated.
3. All Panelboards and distribution boards: Provide both enclosure fronts and doors with full piano type hinges.

2.3 DISTRIBUTION PANELBOARDS

A. Branch-Circuit Breakers: Use bolt-on breakers.

1. Power Distribution Panelboards General: Provide dead-front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors. Equip with copper bus bars with not less than 98-percent conductivity, and with full-sized neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections. Provide molded-case main and branch circuit-breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards. Provide enclosure fronts and doors with full piano type hinges.

B. Distribution panelboards shall be equal to Square D I-Line Power Distribution Panelboards. Power Distribution Panelboards shall be rated minimum R.M.S. Symmetrical as noted on the drawings for the 277/480 Volt and 120/208 Volt panelboards.

C.. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with full piano hinge, and doors with flush locks, piano hinge and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed mounting, where indicated. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

D. Special Features:

1. Surge Protection Devices (SPD): 120kA minimum, UL 1449 3rd edition compliant, bus connected without leads.
2. 84, 56 or 42 pole panelboards as shown on the contract drawings.
3. Arc-Flash labels: Provide an arc-flash label for the exterior of each panelboard.
4. Provide phase label color code chart for each panelboard to comply with the NEC.

2.4 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Lighting and Appliance Panelboards General: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting feeders at top of panel; equip with copper bus bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit-breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral bus for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.

1. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with piano hinge, and doors with piano hinge, flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed. Provide enclosure fronts and doors with full piano type hinges.

C. Double-Width Panels: Where more than 42 poles are indicated or where otherwise indicated, provide two panelboards connected by feed-thru lugs. Contractor shall provide wire and conduit between panels equal to the main incoming feeders.

D. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

E. Molded-Case Circuit Breakers: Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

F. Panelboards shall be made by Square D, type NF. Panelboards shall be rated minimum R.M.S. Symmetrical as shown on the drawings for the 277/480V.

G. Panelboards shall be made by Square D, type NQ. Panelboards shall be rated minimum R.M.S. Symmetrical as shown on the drawings for the 120/208V panelboards.

H. Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, time-delay type fuses, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.

I. Special Features:

1. Provide bus-mounted 120kA Surge Protection Devise (SPD), UL 1449, 3rd edition listed, in panels, where noted on the drawings.
2. Provide enclosure fronts with full piano hinges and doors within the fronts with full piano hinges. Secure fronts with standard manufacturer fastening devices.
3. 84, 56, or 42 pole panelboards as shown on the contract drawings.

4. Arc-Flash labels: Provide an arc-flash label for the exterior of each panelboard.
5. Provide phase label color code chart for each panelboard to comply with the NEC.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which panelboards and enclosures are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF PANELBOARDS:

A. Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation," and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.

D. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

E. Provide properly wired electrical connections for panelboards within enclosures.

F. Fill out panelboard's circuit directory card upon completion of installation work.

G. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panel into accessible ceiling space.

3.3 GROUNDING:

A. Provide equipment grounding connections for panelboard enclosures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

3.4 FIELD QUALITY CONTROL:

A. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energization, check panelboards for electrical continuity of circuits, and for short-circuits.

3.5 ADJUSTING AND CLEANING:

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.6 DEMONSTRATION:

A. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 262416

SECTION 262726– WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. Requirements specified in all other sections of Division 26 apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles
2. Plugs and Plug Connectors
3. Snap Switches
4. Ground Fault Circuit Interrupter Receptacles
5. Wall Plates

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 26 Section "Electrical Identification" for requirements for labels on wall plates.

1.3 SUBMITTALS

A. Product data for each type of product specified.

B. Samples of those products indicated for sample submission in Architect's comments on product data submittal. Include color and finish samples of device plates and other items per Architect's request.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following codes.

B. NFPA 70 "National Electrical Code".

1. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Inc.
2. Leviton.
3. Pass and Seymour Inc.
4. Or approved equal

2.2 WIRING DEVICES:

A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Verify color selections with Architect.

B. Receptacles: Comply with UL 498 and NEMA WD 1. Where not otherwise indicated, provide 20A extra heavy duty, specification grade receptacles. Provide receptacles equal to Hubbell Wiring Devices 5362ST series. Verify color selections with Architect.

C. Where receptacles are wired to normal/emergency or emergency only circuits, provide red colored receptacles, with ratings equal to above.

D. Receptacles, Industrial Heavy Duty: Provide pin and sleeve design receptacles conforming to UL 498. Provide features indicated.

E. Ground-Fault Interrupter (GFI) Receptacles: Provide weather-resistant "feed-thru" type ground-fault circuit interrupter, with integral commercial heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2-3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 943. Provide receptacles equal to Hubbell Wiring Devices GFR20 series, which comply with the latest UL 943 for self-testing requirements. Verify color selections with Architect.

F. USB Charger Receptacles: Provide specification grade tamper-resistant NEMA 5-20R duplex receptacle with (2) integral USB ports; (1) USB Type A, providing 3 Amp, 5VDC, 2.0, complying with battery charging specification USB BC1.2, and (1) USB Type C, 5 Amp, 5VDC, 3.0 power delivery. USB charging shall be compatible with USB 2.0/3.0/3.1 devices, including Apple products. Provide receptacle equal to Hubbell Wiring Device-Kellems USB20AC5. Verify color selections with Architect.

G. Occupancy Controlled Receptacles (OCR): Provide permanently marked with universal power symbol, two faced controlled tamper-resistant receptacle. Receptacle shall comply with NEC 2014-406.3, ASHRAE 90.1, UL 498 and NEMA WD 6. Where not otherwise indicated, provide 20A, specification grade receptacles. Provide receptacles equal to Hubbell Wiring Devices BR20C2GNTR series. Receptacle color shall be green.

H. Recessed receptacle for wall mounted projectors and clocks: Provide recessed receptacle, 20A rated, tamper-resistant, 2 pole, 3 wire, grounding, with side wire terminations. Provide receptacles equal to Hubbell Wiring Device-Kellems RR201CHSSTR. Verify color selections with Architect.

I. Plugs: 15-amperes, 125-volts, 3-wire, grounding, armored cap plugs, parallel blades with cord clamp, and 0.4 inch cord hole; match NEMA configuration with power source's.

J. Plug Connectors: 15-amperes, 125-volts, bakelite-body armored connectors, 3-wire, grounding, parallel blades, double wipe contact, with cord clamp, and 0.4 inch cord hole, match NEMA configuration to mating plug's. Arrange as indicated.

K. Snap Switches: quiet type AC switches as indicated in Table 2 in Part 3 below. Comply with UL 20 and NEMA WD1. Where not otherwise indicated, provide 20A industrial/institutional heavy duty grade switches.

1. Standard Toggle: Provide Hubbell Wiring Device-Kellems 122*-I (* - single pole, double pole, three-way and four-way as required) series or approved equal with colors as selected by the Architect.
2. Piloted Toggle: Provide Hubbell Wiring Device-Kellems HBL122*PL (* - single pole, three-way and four-way as required) or approved equal with colors as selected by the Architect.
3. Standard Key: Hubbell Wiring Device-Kellems HBL122*LI with HBL1209 key for locking (* - single pole, double pole, three-way and four-way as required) series or approved equal with colors as selected by the Architect

2.3 WIRING DEVICE ACCESSORIES

A. Wall plates: single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legend where indicated. Conform to requirements of Section "Electrical Identification." Provide plates possessing the following additional construction features:

1. Material and Finish: 0.04 inch thick, type 302 satin finished stainless steel.
2. Outdoor covers & material for Wet Locations: Cast Aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations." Provide gray while-in-use cover MX2480S by Hubbell Taymac or approved equal for roof locations. All other locations provide clear horizontal Arlington DBH*1C or approved equal. Coordinate mounting types with GC.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.

C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

D. Install wiring devices after wiring work is completed.

E. Install wall plates after painting work is completed.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

3.2 PROTECTION

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

END OF SECTION 262726

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:

1. Feeder and branch-circuit protection.
2. Motor and equipment disconnecting means.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for attachment plugs, receptacles, and toggle switches used for disconnecting means.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. RMS: Root mean square.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switch and circuit breaker.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Current and voltage ratings.
c. Short-circuit current rating.
d. UL listing for series rating of installed devices.

e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

D. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Closeout Procedures," include the following:

1. Routine maintenance requirements for components.
2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA AB 1 and NEMA KS 1.

D. Comply with NFPA 70.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2000 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spares: For the following:

a. Potential Transformer Fuses: One for every 10 installed; minimum of 3.
b. Control-Power Fuses: One for every 10 installed; minimum of 3.
c. Fuses and Fusible Devices for Fused Circuit Breakers: One for every 10 installed; minimum of 3.
d. Fuses for Fused Switches: One for every 10 installed; minimum of 3.
e. Fuses for Fused Power-Circuit Devices: One for every 10 installed; minimum of 3.

2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fusible Switches:

a. Eaton Corp.; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Control Division.
c. Square D Co.
d. Or approved equal

2. Molded-Case Circuit Breakers:

a. Eaton Corp.; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Control Division.

c. Square D Co.
d. Or approved equal

3. Combination Circuit Breaker and Ground-Fault Trip:

a. Eaton Corp.; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Control Division.
c. Square D Co.
d. Or approved equal

2.2 ENCLOSED SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

C. Elevators: Provide (2) NO/NC contacts where indicated and for all disconnects in an elevator machine room.

2.3 ENCLOSED CIRCUIT BREAKERS

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time time adjustments.
d. Ground-fault pickup level, time delay, and I^2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
5. Molded-Case Switch: Molded-case circuit breaker without trip units.
6. Shunt-Trip: Integral shunt-trip module within the Molded-case circuit breaker.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.5 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard grey paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section “Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.4 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
2. Test continuity of each line- and load-side circuit.

B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.

C. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262816

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for standby power supply with the following features:

1. Natural Gas engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Remote annunciator.
5. Performance requirements for sensitive loads.
6. Outdoor sound attenuating enclosure.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Design Calculations: Signed and sealed by a qualified professional engineer in the State of New Jersey. Calculate wind loading in accordance with the 2021 IBC considering generator base concrete slab, anchorage to the slab, and generator/sub-base tank/housing.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For installer and manufacturer.

D. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Comply with NFPA 99.

J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

K. Comply with UL 2200.

L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Refer to Division 26 section “Summary of Work.”

B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 40 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

1.7 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: None.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Caterpillar.
2. Rehlko / Kohler (Basis of Design)
3. Cummins Power Generation; Industrial Business Group
4. Or approved equal.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set model KG80 standby-rated unit as manufactured by Rehlko / Kohler or approved equal by one of the manufacturer’s listed above. Generator max dimensions, including housing: Refer to the contract drawings.

B. Engine-generator set shall comply with EPA certification level required for the generator size.

C. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

D. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

    a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

    a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Natural Gas

B. Rated Engine Speed: 1800RPM.

C. Lubrication System: The following items are mounted on engine or skid:

1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer’s instructions

E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.

1. Designed for operation on a single 120 VAC, Single phase, 60Hz power connection. Heater voltage shall be shown on the project drawings.
2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
3. Provided with a 12VDC thermostat, installed at the engine thermostat housing

F. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.

G. Cooling System: Closed loop, liquid cooled

1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.
2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.

H. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.
1. Exhaust pipe on exterior of the enclosure and hinged rain cap shall be schedule 10 stainless steel.

I. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.

J. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.

4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:

    a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide an LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
    f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation:
    1. When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
    2. Provide with generator start circuit integrity monitoring controls between generator and two automatic transfer switches and quick-connect cabinet, to comply with NFPA 70.

B. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel features shall include the following:

1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
2. Current and Potential Transformers: Instrument accuracy class.
3. APM402 series microprocessor based control operator display panel with (3) auxiliary relays and RS-485 monitoring or approved equal by one of the manufacturers listed above.

C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Fuel tank derangement alarm.
11. Fuel tank high-level shutdown of fuel supply alarm.
12. Generator overload.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals.

F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

1. Overcrank shutdown.
2. Coolant low-temperature alarm.
3. Control switch not in auto position.
4. Battery-charger malfunction alarm.
5. Battery low-voltage alarm.

G. Remote Alarm Annunciator: Comply with NFPA 99 and 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are flush-mounting type to suit mounting conditions indicated. Connection shall be via RS-485 communications protocol plus 2#12 wiring for 24VDC power.

H. Remote emergency stop mushroom button.

I. Communications: Modion Gateway to convert to Modbus RS-485.

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breakers: Molded-case, electronic-trip LSI type; 80 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.
5. Size and Quantity: As per the contract drawings.
6. Shall be selectively coordinate with downstream life safety panel breakers. Provide adjustable trip, solid state electronic LSI trip units, where indicated on the drawings.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H

D. Temperature Rise: 105 environment.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Shunt Excitation

G. Enclosure: Drip-proof.

H. Voltage Regulator: SCR type, Separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.

I. The alternator shall be provided with anti-condensation heater(s) in all applications where the generator set is provided in an outdoor enclosure, or when the generator set is installed in a coastal or tropical environment.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 15 percent maximum, based on the rating of the engine generator set.

2.7 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of

sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Natural rubber.
2. Number of Layers: Two.

2.8 ENCLOSURES

A. Level 2 sound attenuating steel enclosure. 8 position average sound pressure level @ 7 meters from the enclosure shall be 69 dB(A).

2.9 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

F. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Use Hilti HIT HY-200 epoxy embedment system with a minimum of (8) ¾" galvanized anchors with a minimum embedment of 6".

3.3 CONNECTIONS

A. Connect engine exhaust pipe to engine with flexible connector.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
c. Verify acceptance of charge for each element of the battery after discharge.
d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
7. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations, and compare measured levels with required values.
8. Onsite Load Bank Test: Provide 2 hour full 100% load resistive load bank test.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Provide minimum 4 hours of on-site training for the Owner’s personnel.

END OF SECTION 263213

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches: 3-pole or 4-pole, as noted on the drawings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

C. Qualification Data: For manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA ICS 1.

F. Comply with NFPA 70.

G. Comply with NFPA 99.

H. Comply with NFPA 110.

I. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:
   a. ASCO Power Technologies, LP. (Basis of Design).
   b. Caterpillar
   c. Kohler
   d. Cummins
   e. Or approved equal

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

2. ATS Switches on this project shall have a minimum withstand rating as follows. Provide required upstream fuses to meet this requirement, as required.
   a. 35,000A RMS for the Life Safety ATS
   b. 35,000A RMS for the Optional Standby ATS

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral: Solid or switched neutral, as noted on the drawings.

H. Neutral Terminal: Fully rated.

I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Equal to ASCO 300 Series automatic transfer switch with microprocessor based transfer control center.

C. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

D. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

G. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

H. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Digital LCD screen power manager equal to ASCO Power Manager Xp. Features shall include ability to monitor and display:
    a. Phase-to-Phase Voltages, Phase-to-Neutral Voltages
    b. Phase and Neutral Currents
    c. Frequency
    d. Apparent Power (kVA)
    e. Reactive Power (kVAR)
    f. Real Power (kW)
    g. Power Factor
11. Additional auxiliary contact sets to indicate switch position. Two sets are standard. Specify total number of sets if more are required.
12. Two-pole, double-throw contacts operate when emergency source voltage is present at transfer switch terminals.
13. Two-pole, double-throw contacts operate when normal source voltage is present at transfer switch terminals.
14. Push-to-Test feature on all pilot light indicators.
15. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
16. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
17. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.
18. Load side external surge protection unit rated 100kA per phase with through door rotary disconnect switch.
    a. Provide ASCO 460-277Y-10-T-C-E-1 surge protection device in NEMA 1 enclosure.
19. Generator start circuit integrity monitoring controls, to comply with NFPA 70-2020, equal to ASCO 5101 series.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

B. Identify components according to Division 26 Section "Identification for Electrical Systems."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

B. Coordinate tests with tests of generator and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel for a minimum of 2 hours to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following:
   1. Materials.
   2. Finishes.
   3. Luminaire support.

B. Related Requirements:

   1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relay panes, and architectural dimming systems and for LED dimming controls with dimming drivers specified in interior lighting Sections.

   2. Refer to Lighting Fixture Schedule on Contract Drawings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:

1. ENERGY STAR certified.
2. California Title 24 compliant.
3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
5. UL Listing: Listed for damp location.
6. Recessed luminaires shall comply with NEMA LE 4.

C. CRI of minimum 80. CCT, as noted in Lighting Fixture Schedule.

D. Rated lamp life of 50,000 hours to L70.

E. Lamps dimmable from 100 percent to 10 percent of maximum light output in classrooms and common spaces. Lecture Hall fixture shall be dimmable from 100 percent to 1 percent.

F. Internal driver, unless otherwise noted.

G. Nominal Operating Voltage: As noted in Lighting Fixture Schedule.

1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers, and Globes:
1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.5 LIGHTING FIXTURE SCHEDULE

A. General: Various fixture types required are indicated below. Fixtures must comply with minimum requirements as stated herein. Review architectural drawings and specifications to verify ceiling types, modules, suspension systems appropriate to installation. In general, where so noted, substitutions for different type of fixture will be acceptable, based only on the alternate manufacturer listed for the specific fixture type, and on objective criteria as submitted in accordance with Instructions to the Bidders.

B. A contractor submitted shop drawing for the lighting fixtures, stamped as Approved by the contractor, constitutes that the contractor has reviewed, coordinated and approved all information (number and quantity of switching devices, ceiling types, wiring schemes, etc.) on the Electrical and Architectural drawings.

C. Refer to the contract drawings for the lighting fixture schedule.

1. Model numbers are shown for information only. The written description for each fixture shall supersede the model number. It shall be the contractor's responsibility to verify all model numbers. All final fixture finishes shall be selected by the Architect prior to fixture approval. Contractor shall bid on the most expensive finish available for each fixture, unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Wall-Mounted Luminaire Support:
1. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod, wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specification Section, apply to work of this Section.

B. All the requirements of all the Division 26 Sections apply to this Section.

1.2 SUMMARY:

A. Extent, location, and details of lighting fixture work are indicated on drawings and in schedules.

B. Outdoor lighting control panels, refer to section “Lighting Control Devices.”

C. Types of lighting fixtures in this section include the following:

1. LED

1.3 SUBMITTALS:

A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections.

B. Product Data: Submit manufacturer's product data and installation instructions on each type interior and exterior building lighting fixture and component.

C. Shop Drawings: Submit layout drawings of lighting fixtures and their spatial relationship to each other. In addition, submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in "laminar type" alphabetical or numerical order, with proposed fixture and accessories clearly indicated on each sheet. Drawings shall indicate complete details of fixture, including manufacturer's catalog numbers for sockets, ballasts, lamps, lightshields, lenses, metal gauges, type of wiring, finish color and texture.

D. Note for Product Data and Shop Drawing submittals: The shop drawings will be immediately rejected if specific ballasts and lamps, as well as the other data indicated above, are not provided.

E. Wiring Diagrams: Submit wiring diagrams for auditorium lighting showing connections to electrical power panels, switches, dimmers, controllers, and feeders. Differentiate between portions of wiring which are manufacturer-installed and portions which are field-installed.

F. A contractor submitted shop drawing for the lighting fixtures, stamped as Approved by the contractor, constitutes that the contractor has reviewed, coordinated and approved all information (number and quantity of switching devices, wiring schemes, etc.) on the Electrical and Architectural drawings.

1.4 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting fixtures of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 410, and 510 as applicable to installation, and construction of building lighting fixtures.
2. NEMA Compliance: Comply with applicable requirements of NEMA Stds Pub/No.'s LE 1 and LE 2 pertaining to lighting equipment.
3. IES Compliance.
4. UL Compliance: Comply with UL standards, including UL 486A and B, pertaining to lighting fixtures. Provide lighting fixtures and components which are UL-listed and labeled.
5. CBM Labels: Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBM label.

1.5 WARRANTY

A. The contractor shall warrant the completed lighting system wiring, equipment, lamps and ballasts to be free from inherent mechanical and electrical defects for a period of 1 years from the date of Substantial Completion. Refer to Division 1 specifications for definition of Substantial Completion.

B. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

C. Warranty Period: 5 years from date of Substantial Completion.

D. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of “Substantial Completion.”

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from damage.

B. Store lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.

C. Handle lighting fixtures carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.7 SEQUENCING AND SCHEDULING:

A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of lighting fixtures with other work.

B. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

1.8 GENERAL

A. Furnish lighting fixtures, lighting equipment components, branch circuiting and lamps for a complete lighting system. All incandescent fixtures shall be prewired type.

B. The driver and all other parts shall be considered as components of the fixture, and it shall be the responsibility of the manufacturer of the fixture to furnish labor and material required to repair or replace any or all of the components that become defective during the guarantee period stated in this specification.

C. Location of fixtures on drawings is diagrammatic. Verify locations with site plans, or other reference data for final location and spacing in advance of installation. Examine space conditions and requirements for installation of fixtures. Coordinate installation of fixtures with other trades to avoid interferences.

D. Wiring channels and socket mountings shall be rigid and accurately made. Sockets shall hold lamps securely against normal vibration and maintenance handling. Socket contacts shall be silver plated. For rapid start lamps on single ballasts, furnish one grounding socket.

E. Provide approved support for each lighting fixture outlet.

F. Blemished, damaged, or unsatisfactory fixtures shall be replaced at the direction of the Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or alternatives of the quality necessary to meet the specifications. Manufacturer for each type of fixture are indicated in the fixture schedule.

2.2 FIXTURES:

A. General: Provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not limited to, housings, energy- efficient lamps, lamp holders, reflectors, energy efficient ballasts, starters and wiring. Ship fixtures factory-assembled, with those components required for a complete installation. Design fixtures with concealed hinges and catches, with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise. All High Intensity Discharge fixtures shall be equipped with high impact glass lenses.

B. Refer to Section 265119 for luminaire requirements on this project.

C. Refer to the contract drawings for the lighting fixture schedule.

1. Model numbers are shown for information only. The written description for each fixture shall supersede the model number. It shall be the contractor's responsibility

to verify all model numbers. All final fixture finishes shall be selected by the Architect prior to fixture approval. Contractor shall bid on the most expensive finish available for each fixture, unless otherwise noted.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which lighting fixtures are to be installed, and substrate for supporting lighting fixtures. Notify Architect in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF EXTERIOR LIGHTING FIXTURES:

A. Install exterior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B, and the National Electrical Code.

C. Fasten electrical lighting fixtures and brackets securely to indicated structural supports, including poles/standards; and ensure that installed fixtures are plum and level.

D. The Electrical Contractor will furnish and install photocells to control the outdoor lighting circuits.

3.3 FIELD QUALITY CONTROL:

A. Replace defective and burned out lamps for a period of one year following the Date of Substantial Completion.

3.4 ADJUSTING AND CLEANING:

A. Clean lighting fixtures of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.

B. Protect installed fixtures from damage during remainder of construction period.

3.5 GROUNDING:

A. Provide equipment grounding connections for interior and exterior lighting fixtures as required. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

B. Refer also to section Grounding.

END OF SECTION 265619

SECTION 283111 – DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary General Conditions of the Specification sections, apply to work of this section.

B. Division 26 & 28 sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Provide new fire alarm control panels with voice evacuation features with all necessary power supplies, batteries, NAC and booster supply panels, notification appliances, initiation devices, and all necessary programming, testing, and commissioning.

B. The existing campus networked 4100ES fire alarm system is installed and serviced by JCI / Simplex. Contractor is responsible to contact JCI / Simplex for system requirements, networking, equipment, installation and testing for this project.

C. New fire alarm control panel shall be networked with fiber optic cabling to nearest existing fire alarm panel for network communication, including adding fiber optic communication equipment to nearest existing fire alarm panel to allow new fire alarm panel to be networked to existing fire alarm panels via new fiber optic cables.

D. In renovation areas, after relocated and/or new devices are installed, the fire alarm system shall be completely retested in accordance to NFPA 72 requirements. This test must be witnessed by the Owner and the Local Fire Marshal.

E. The complete installation is to conform to the applicable sections of NFPA-72, NFPA 90A, Local Code Requirements and National Electrical Code with particular attention to Article 760. Additionally, the entire installed system and all integrated system operations shall be within the guidelines of the 2021 ICC code series and ANSI A117.1, including all the latest revisions.

F. Provide system modifications suitable for type occupancy as defined by local Building Code and as approved by local Fire Marshal. Prior to commencing the construction work, contact the local Fire Marshal, and obtain all the necessary approvals.

1.3 QUALITY ASSURANCE:

A. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by the Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable.

B. The equipment and installation supervision furnished under this specification is to be provided by a manufacturer who has been engaged in production of this type (software driven) of equipment for at least ten (10) years.

C. The system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.

D. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with fire alarm systems work similar to that required for this project.

1. Firm with manufacturer's factory trained personnel.
2. Firm with factory authorized service organization and spare parts stock.
3. All control equipment must have transient protection devices to comply with UL 864 requirements. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.

E. Codes and Standards:

1. NEC Compliance: Comply with applicable requirements of NEC standards pertaining to fire alarm systems.
2. UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to fire alarm systems; and provide products and components which are UL-listed and labeled.
3. FM Compliance: Provide fire alarm systems and accessories which are FM-approved.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of fire alarm system equipment. Include custom riser and wiring diagrams, and operation and maintenance instructions for inclusion in maintenance manuals.

B. Shop Drawings: Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm system. Include wiring and riser diagrams specific for each condition. Shop drawings shall be signed and sealed by a Professional Engineer licensed in the state of New Jersey.

C. Battery & Voltage Drop Calculations: Provide battery calculations for the existing fire alarm panel and any new notification appliance power panels, as per NFPA 72. Calculations shall be signed and sealed by a Professional Engineer licensed in the state of New Jersey.

D. Testing and Reports

1. Upon completion of the system's installation, an approved representative of the system manufacturer shall be employed to conduct a thorough test of the system and submit a written report of the findings to the architect. The test shall include at the least, verifying the following:

a. The functional operation of each re-settable initiating device (manual stations, detectors, etc.) and circuit.
b. The functional operation of each and every alarm device and circuit.
c. The functional operation of each monitored device circuit.
d. The functional operation of each control circuit.
e. The supervision function of each Initiating, Indicating, Monitoring, Control and Supply Circuit.
f. Control station automatic signaling.
g. The Style B, Style C, Style D, Style E or bi-directional fault tolerant operation of each circuit.

E. As-Built / Maintenance Data: Contractor shall provide an exact as-built plan of the new fire

alarm wiring and devices installed in this project. This shall include all devices, conduit sleeves, conduit stubs and EXACT wiring locations, routing and configuration in the building.

F. Maintenance Data: Submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Handle fire alarm equipment carefully to prevent damage, breaking, and scoring. Do not install damaged equipment or components; replace with new.

B. Store fire alarm equipment in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

1.6 WARRANTY

A. All components, parts and assemblies supplied by the manufacturer shall be guaranteed against defects in materials and workmanship for a period of 12 months following Substantial Completion. Warranty service shall be provided by a trained specialist of the equipment manufacturer who shall be based in a fully staffed, fully stocked (replacement parts and test equipment) branch office, located within 50 miles of the site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer:
1. JCI/SimplexGrinnell. (NO SUBSTITUTIONS, as it is required to communicate with existing networked JCI/SimplexGrinnell fire alarm panels).

2.2 FIRE ALARM CONTROL PANEL (FACP) SimplexGrinnell 4100ES, networkable system

A. General: Comply with UL 864, "Control Panels for Fire-Protective Signaling Systems."

B. The following FACP hardware shall be provided:

1. Power Limited base panel with beige cabinet and door, 120 VAC, 60 HZ input power.
2. 250 Addressable point capacity inclusive of inputs and outputs in any combination.
3. Three (3) Class B/Style Y Notification Appliance Circuits (NAC; rated 2A @ 24VDC, resistive);
4. Two form "C" Auxiliary Output Circuits (rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory or other selective control operations. Provide capability for switching up to ½ A @ 120VAC, inductive loads.
5. The FACP shall be capable of supporting two (2) RS-232-C ports.
6. Supervised serial communication channel for control and monitoring of remotely located LCD annunciators and I/O panels.
7. Common Event DACT.
8. Ethernet network IP/Cellular DACT equipment via CAT6 cables to patch panel in IT

Closet.

C. Cabinet: Lockable steel enclosure. Arrange panel so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single panel is required to form a complete control panel, provide exactly matching modular panel enclosures.

D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

2.3 REMOTE LCD ANNUNCIATOR

A. Provide Remote LCD Annunciator(s) as required with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the FACP.

B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with three (3) programmable LEDs (two selectable as red or yellow; one selectable as green or yellow).

C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

E. The LCD shall display the following information relative to the abnormal condition of a point in the system:

1. 40 character custom location label.
2. Type of device (e.g., smoke, pull station, waterflow).
3. Point status (e.g., alarm, trouble).

F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

2.4 EMERGENCY POWER SUPPLY

A. General: Components include battery, charger, and an automatic transfer switch.

B. Battery: Sealed lead-acid type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all notification appliances in alarm or supervisory mode for a period of 5 minutes.

2.2 ADDRESSABLE INITIATING DEVICES

A. ADDRESSABLE MANUAL PULL STATIONS - SimplexGrinnell 4099-9003
   1. Description: Addressable single- or double-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.
   2. Protective Shield: Provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations.

B. SMOKE SENSORS - SimplexGrinnell 4098 Series
   1. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
      a. Factory Nameplate: Serial number and type identification.
      b. Operating Voltage: 24 VDC, nominal.
      c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
      d. Each sensor base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
      e. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
      f. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
      g. The sensor's electronics shall be immune from nuisance alarms caused by EMI and RFI.
      h. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACU. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
      i. Removal of the sensor head for cleaning shall not require the setting of addresses.

   2. Type: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type.
   3. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.
   4. Duct Smoke Sensor: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.
      a. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACU.
      b. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
      c. Duct Housing shall provide a relay control trouble indicator Yellow LED.
      d. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

e. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
f. Duct Housing shall provide a magnetic test area and Red sensor status LED.
g. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
h. Each duct smoke sensor shall have a Remote Test Station with an alarm LED and test switch.
i. Where indicated provide a NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

C. HEAT SENSORS - SimplexGrinnell 4098 Series

1. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.
2. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
3. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACU for either 15-deg F or 20-deg F per minute.
4. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

D. CARBON MONOXIDE DETECTOR BASE - SimplexGrinnell 4098 series

1. Carbon Monoxide (CO) sensor base shall contain a CO sensing module providing both CO toxic gas monitoring/detection and enhanced fire detection.
2. CO sensor shall be listed as a UL2034 CO alarm detection device.
3. CO Sensor base shall consume only one IDNET address, and act as either an independent sensor, or selectable multi-sensor modes of False Alarm Reduction or Faster Detection.
4. CO sensor element shall be replaceable when end of service life is reached.

E. ADDRESSABLE CIRCUIT INTERFACE MODULES - SimplexGrinnell 4090 Series

1. Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.
2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.
3. There shall be the following types of modules:
   a. Type 1: Monitor Circuit Interface Module:
      1) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACU.

2) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACU.

b. Type 2: Line Powered Monitor Circuit Interface Module
   1) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACU.
   2) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

c. Type 3: Single Address Multi-Point Interface Modules
   1) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.
   2) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.
   3) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

d. Type 4: Line Powered Control Circuit Interface Module
   1) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

e. Type 5: 4-20 mA Analog Monitor Circuit Interface Module
   1) This module shall communicate the status of a compatible 4-20 mA sensor to the FACU. The FACU shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

4. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACU. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.3 ADDRESSABLE NOTIFICATION DEVICES

A. STANDARD ALARM NOTIFICATION APPLIANCES - SimplexGrinnell, 4906 Series

C. Speaker: High quality voice and tone reproduction with taps for 1/4 W, 1/2 W , 1 W, or 2 W, at 25 VRMS or 70.7 VRMS. Capacitor input for connection to supervised notification appliance circuits. Speakers are wired separately from strobe wiring. UL listed to Standard 1480 and ULC-S541.

D. Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different field-selectable flash intensities of 15cd, 30cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.

E. Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide field-selectable candela intensities and label inside the strobe lens to indicate the listed candela rating of the specific strobe. The speaker shall have a minimum sound pressure level of 85 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.

F. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.

G. Speaker circuit shall provide voice communications over a twisted, shielded pair of wires.

H. Wall or ceiling mounted devices, as per the drawings. Provide extra deep backboxes to house the speaker transformer and taps.

I. Provide wireguards in gyms and where noted on the drawings.

J. All devices shall be white and shall be labeled with “Alert”, NOT “Fire”.

K. Manufacturer shall determine the appropriate candela value of each strobe based on the layout of the floor plans. The candela values shall be indicated on the submitted shop drawings. Synchronization flash modules shall be provided, as required.

B. NAC Power Extender - SimplexGrinnell 4009 series

1. The IDNet NAC Power Extender panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be Class B, Style Y rated at 2 amps each. Panel shall provide capability to be expanded to 8 notification appliance circuits.

2. The internal power supply and battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.
3. The NAC extender panel may be mounted close to the host control unit or can be remotely located. The IDNET Addressable NAC Extender Panel when connected to an addressable panel shall connect to the host panel via an IDNet communications channel. Via the IDNET channel each output NAC can be individually controlled for general alarm or selective area notification.
4. For IDNet connected NAC extender panels up to five panels can be connected on a single IDNet channel.
5. When connected to a conventional (non-addressable panel) one or two standard notification appliance circuits from the main control unit may be used to activate all the circuits on the NAC power extender panel.
6. Alarms from the host fire alarm control unit shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

2.4 ADDITIONAL SYSTEM FEATURES

A. Magnetic Door Holders:

1. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 24VAC or a 24VDC source, and develop a minimum of 25 lbs. holding force.
2. Material and Finish: Match door hardware.

2.4 WIRING SYSTEM MATERIALS

A. Provide basic wiring materials which comply with Division-26 “Low Voltage Electrical Power Conductors and Cables; types to be selected by Installer.

1. System shall be installed with all conduits, conductors, outlet boxes, fittings, connectors and accessories necessary to ensure a complete, operable system in compliance with all applicable codes and regulations.
2. Conduit: Conduits shall be installed in accord with Division-26 “Low Voltage Electrical Power Conductors and Cables”.
3. Wire and Cable: All wiring shall be installed in metal conduit or within equipment. Conductors shall be installed in accord with Division-26 “Low Voltage Electrical Power Conductors and Cables”. Conductors within equipment enclosures shall be carefully cabled and laced. Individual conductors shall be tagged with E-Z code markers indicating circuit number and type. Markers shall be used on all conductors at each outlet or pull box at each equipment enclosure.
4. T-tapped connections will not be allowed on any supervised circuits. Connections shall be made directly to and from device terminal screws. Screw terminals shall have rising plates to terminate more than one wire or each wire shall be terminated to individual screws or each wire shall terminate in a ring lug.
5. Provide conductors which are listed and approved for fire alarm usage.

B. Junction Boxes: Provide fire alarm junction boxes painted red enamel. Provide each box with suitable number of terminals and of proper size to hold wiring.

PART 3 - EXECUTION

3.1 INSTALLATION OF BASIC WIRING SYSTEM MATERIALS:

A. Install wiring, raceways, and electrical boxes and fittings in accordance with "Raceways and Boxes for Electrical Systems" and “Low-Voltage Electrical Power Conductors and Cables”, for wiring of non-power limited circuits. Install wiring in conduits recessed in walls.

B. Provide and install the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations. All wiring, if installed in conduit, shall be in a completely separate conduit system. All wiring shall be installed in strict compliance with all the provisions of NEC - Article 760, Power-Limited Protective Signaling Circuits. Use conduits in the exposed and unprotected areas, and only cables rated for use in Environmental Air Plenums.

C. All junction boxes shall be sprayed red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation.

D. Install wires and cables without splices. Make connections at terminal strips in cabinets or at equipment terminals. Make soldered splices in electronic circuits in control cabinets.

3.2 INSTALLATION OF FIRE ALARM SYSTEMS:

A. Install fire alarm system as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "Standard of Installation."

B. Wiring: Wiring of fire alarm system is work of this section, but is not specifically detailed on drawings.

1. Complete wiring in accordance with manufacturer's requirements. Color code wiring and install per manufacturer's point-to-point wiring diagram. Determine exact number of wires for each fire area zone from number and types of devices installed. Connect each device with sufficient wiring to complete its intended operation.
2. Where there are a number of power requiring devices, such as smoke detectors and fan control relays, installed in a circuit, group in numbers so power required does not exceed 80% of manufacturer's power supply rating. Provide extra wiring, or extra power supplies required to fulfill that requirement. In addition, provide extra or larger size wiring to alleviate voltage drops which makes device operate beyond voltage limits for which it was designed. Determine above with manufacturer's representative while equipment is being installed.
3. Contractor shall provide an exact as-built plan of the new fire alarm wiring installed in this project. This shall include all devices, conduit sleeves, conduit stubs and EXACT wiring locations in the building. See Submittals above.

3.3 FIELD QUALITY CONTROL:

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.
2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
3. International Municipal Signal Association (IMSA) fire alarm certified.
4. Certified by a state or local authority.
5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Inspection:
1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Acceptance Operational Tests:

1. Perform operational system tests to verify conformance with specifications:
   a. Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified. Test Supervising Station Signal Transmitter. Coordinate testing with Supervising Station monitoring firm/entity.
   b. Test each Notification Appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.
   c. Test Fire Alarm Control Unit and Remote Annunciator.

2. Provide minimum 10 days notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation.

H. Final Test, Record of Completion, and Certificate of Occupancy:
1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

END OF SECTION 283111

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping, or sealing site utilities.
7. Temporary erosion and sedimentation control.

1.2 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

E. Traffic control shall be provided along Springfield Avenue as required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

C. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Grind down stumps and remove roots larger than 3 inches (75 mm) in diameter, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.
2. Use only hand methods or air spade for grubbing within protection zones.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm) and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subbase course and base course for asphalt paving.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 INFORMATIONAL SUBMITTALS

A. Material test reports.

1.4 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

B. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: Narrowly graded mixture of [**washed**]crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches (300 mm) each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

E. Initial Backfill: Place and compact initial backfill of subbase materials, free of particles larger than 1 inch in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Shape subbase course and base course to required crown elevations and cross-slope grades.
2. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.15 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform inspections:

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.

B. Related Requirements:

1. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the New Jersey Department of Transportation (NJDOT).

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of NJDOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

B. Fine Aggregate: **ASTM D,** sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

C. Mineral Filler: ASTM D 242/D 242M, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: Shall conform with NJDOT requirements.

B. Tack Coat: Shall conform with NJDOT requirements.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

2.4 MIXES

A. Recycled Content of Hot-Mix Asphalt: Shall conform to NJDOT requirements.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by NJDOT and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: 19M64.
3. Surface Course: 9.5M64.

PART 3 - EXECUTION

3.1 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.2 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Spread mix at a minimum temperature of 250 deg F (121 deg C).
2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Replace and compact hot-mix asphalt where core tests were taken.

C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.8 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes Concrete Paving including the following

1. Driveways.
2. Curbs.
3. Walks.
4. Concrete Pads.
5. Walks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of product, ingredient, or admixture requiring color selection.

C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

2.2 STEEL REINFORCEMENT

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.

E. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars[; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating]. Cut bars true to length with ends square and free of burrs.

F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.3 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Cementitious Materials: Shall be in conformance with New Jersey Department of Transportation (NJDOT) Standard Specifications for Road and Bridge Construction, 2007 Edition.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S, uniformly graded. Provide aggregates from a single source.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

F. Water: Potable and complying with ASTM C 94/C 94M.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats].

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

B. Cementitious Materials: In accordance with NJDOT Standard Specifications. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: In accordance with NJDOT Standard Specifications.

C. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

D. Concrete Mixtures: In accordance with NJDOT Standard Specifications.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M [and ASTM C 1116/C 1116M]. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness[, to match jointing of existing adjacent concrete paving]:

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

B. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed paving surface with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

1. Float Finish: In accordance with NJDOT Standard Specifications.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing curing compound or a combination of these.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 (ACI 117M) and the NJDOT Standard Specifications

3.10 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes painted markings applied to asphalt pavement.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint: Shall be in conformance with New Jersey Department of Transportation (NJDOT) Standard Specifications for Roadway and Bridge Construction.

PART 3 - EXECUTION

3.1 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils. Apply paint so that it cannot run beneath the stencil.
2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal. (0.72 kg/L).

END OF SECTION 321723

SECTION 329200 – TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Topsoiling.
2. Seeding.
3. Sodding.

1.2 DEFINITIONS

A. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

B. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

C. Topsoil: Natural, fertile soil capable of sustaining vigorous plant growth.

1.3 INFORMATIONAL SUBMITTALS

A. Certification of grass seed.

1. Certification of each seed mixture.

B. Product certificates.

1. Testing data for topsoil.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
2. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

   a. Landscape Industry Certified Technician - Exterior.
   b. Landscape Industry Certified Lawncare Manager.
   c. Landscape Industry Certified Lawncare Technician.

3. Pesticide Applicator: State licensed, commercial.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Grass-Seed Mix:

1. Products: NJDOT Type A-3 seed mix.

2.2 TURFGRASS SOD

2.3 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: [1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

2.4 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

2.5 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.5 TOPSOIL

A. General: Topsoil shall be loamy sand, sandy loam, clay-loam, loam, silt loam, or other soil approved by the Engineer. It shall be natural, fertile soil capable of sustaining vigorous plant growth and shall be of a uniform quality, free from subsoil, slag, cinders, stones 1 inch or larger in any dimension, lumps of soil, sticks, roots, trash, or other extraneous, undesirable materials. Topsoil shall also be free of viable plants or plant parts of Bermuda grass, quackgrass, Johnson grass, nut sedge, poison ivy, Canada thistle, or similar material. The contractor shall have all topsoil tested by a reputable laboratory with resulting documentation submitted to the Engineer.

B. If testing reveals that the topsoil does not conform to the requirements of this section, the contractor shall be responsible for adjusting the ph range and/or percent of organic matter by means of approved additives.

C. Topsoil shall meet the following requirements:

1. ph range - 5.0 to 7.0.
2. Organic matter - four (4) percent (loss on ignition).
3. Soluble salts no higher than 500 parts per million.
4. Sieve Analysis:

Sieve Size	Percent Passing
1"	100%
½"	97%
#10	60-80%
#40	40-60%
#60	40-60%
#100	10-30%
#200	10-20%

D. When topsoil, stockpiled on site, is to be reused, soil debris to include roots, sods, stones, clay lumps, and other extraneous materials harmful to plant growth shall be removed prior to reuse.

E. Materials stripped from the following sources shall not be considered suitable for use as topsoil:

1. Soils having less than 4.1 ph value.
2. Chemically contaminated soils.
3. Areas from which the original surface has been stripped and/or covered over such as borrow pits, open mines, demolition sites, dumps, and sanitary landfills.
4. Wet excavation.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

A. General: Prepare graded area for topsoil placement

B. Scarify the area to be topsoiled to improve the bond between slope and topsoil. Remove from the scarified area stones 2 inches or larger in any dimension and other debris such as wires, cables, tree roots, pieces of concrete, clods and lumps.

C. After the Engineer has approved the prepared surface elevations, spread topsoil and smooth to grade to produce the required thickness.

D. Ensure that ground areas are not damaged by the delivery, handling or storage of materials; by washouts due to drainage diversion; by workers; or by equipment. Repair such damage by grading, fertilizing, seeding and mulching as specified herein.

3.2 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h).

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket in loose thickness over seeded areas.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.3 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.4 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings.

3.5 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Engineer:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

4.0 QUANTITY AND PAYMENT

Separate payment will not be made for restoration of disturbed areas with topsoiling, fertilizing and seeding, but the cost shall be included in the various items of the proposal.

END OF SECTION 329200

SECTION 329201 – TEMPORARY SOIL EROSION & SEDIMENT CONTROL MEASURES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Refer to Divisions 0 and 1 as they form a part of this Section.

B. This work shall consist of temporary control measures ordered by the Engineer during the life of the contract and as shown on plans, to control erosion and sediment through use of berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses and other erosion control devices or methods.

C. The primary objective of this specification is to control soil erosion to the maximum extent practicable commensurate with reasonable and economical construction practices.

D. The temporary control provisions contained herein shall be coordinated with the permanent erosion control features (grass, pavement and other restorations) specified elsewhere in the contract to the extent practical to assure economical, effective and continuous erosion control throughout the construction and post-construction period.

E. The erosion control measures described herein shall be continued until the construction is complete and final restorations installed.

F. Wherever construction exposes work which is subject to erosion, the extent of such exposure in advance of the subsequent construction shall be subject to the approval of the Engineer. Erosion control features or other work to be completed within such areas shall follow as soon after exposure as practicable.

G. All materials and methods of construction shall be in accordance with the New Jersey State Standards for Soil Erosion and Sediment Control, and as depicted on the Soil Erosion and Sediment Control Plans.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall conform to that depicted on the Soil Erosion and Sediment Control Plan.

PART 3 - EXECUTION

3.1 METHODS OF CONSTRUCTION

A. Preconstruction Conference

1. At the preconstruction conference or prior to the start of the applicable construction, the Contractor shall submit for acceptance his schedules for accomplishment of temporary and permanent erosion control work, as are applicable for excavation work, and any other elements of the project which may contribute to ground erosion of siltation. No work shall be started until the erosion control schedules and methods of operations have been accepted by the Engineer.

B. Construction Requirements

1. The Engineer has the authority to limit the surface area of erodible earth material exposed by excavation and grading operations, and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams, water courses, or bodies of water. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains, and use of temporary mulches, mats, seeding or other control devices or methods as necessary to control erosion. Cut slopes shall be temporarily seeded and mulched as the excavation proceeds to the extent considered desirable and practicable.
2. The Contractor will be required to incorporate all permanent erosion control features to include the required pavement and grass restorations into the project at the earliest practicable times as outlined in his accepted schedule. Temporary control measures will be used to correct conditions that develop during construction that were not foreseen during the design stages that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.
3. Where erosion is likely to be a problem, excavation and grading operations shall be so scheduled and performed that permanent erosion control features can follow immediately; otherwise temporary erosion control measures may be required between successive construction stages.
4. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal or state or location agencies, the more restrictive, laws, rules or regulations shall apply.
5. The Contractor will be responsible for maintaining all soil erosion and sediment control measures in an acceptable manner. All temporary measures shall be removed by the Contractor as directed by the Engineer.

END OF SECTION 329201

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants.

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

C. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

D. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples of each type of mulch.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year.

1.6 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

B. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

C. Handle planting stock by root ball.

D. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.8 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures including plantings falling or blowing over.

2. Warranty Periods: From date of Substantial Completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 24 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 24 months.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Shredded hardwood.

2.4 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101g/sq. m) minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd. (162 g/sq. m).

2.5 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil.

B. Placing Planting Soil: Blend planting soil in place.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter.
3. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.

B. Backfill Soil: Subsoil and topsoil removed from excavations [may] [may not] be used as backfill soil unless otherwise indicated.

3.3 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Backfill: Planting soil.
2. Balled and Burlapped Stock: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Balled and Potted and Container-Grown Stock: Carefully remove root ball from container without damaging root ball or plant.
4. Fabric Bag-Grown Stock: Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
5. Bare-Root Stock: Support stem of each plant and spread roots without tangling or turning toward surface. Plumb before backfilling, and maintain plumb while working. Carefully work backfill around roots by hand. Bring roots into close contact with the soil.
6. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
7. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.

    a. Bare-Root Stock: Place tablets beside soil-covered roots; do not place tablets touching the roots.
    b. Quantity: Two per plant.

8. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.4 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.5 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.6 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches (150 mm) and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated on the landscaping drawings.

3.7 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

D. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

F. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.8 MAINTENANCE SERVICE

A. Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period for Trees and Shrubs: Until final project closeout/acceptance by Owner.
2. Maintenance Period for Ground Cover and Other Plants: Until final closeout/acceptance by Owner.

END OF SECTION 329300

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Dielectric fittings.
3. Sleeves.
4. Identification devices.
5. Grout.
6. Piping system common requirements.
7. Equipment installation common requirements.
8. Concrete bases.
9. Metal supports and anchorages.

1.2 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness, unless otherwise indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Co.
    b. Central Plastics Company.
    c. Epco Sales, Inc.

d. Hart Industries, International, Inc.
e. Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Wilkins Div., or
g. Approved equal.

2. Description: Factory fabricated, union, NPS 2 (DN 50) and smaller.

a. Pressure Rating: 150 psig (1035 kPa) minimum at 180 deg F (82 deg C).
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Water Technologies, Inc., or
e. Approved equal.

2. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) and larger.

a. Pressure Rating: 150 psig (1035 kPa) minimum.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Calpico, Inc.
b. Lochinvar Corporation., or
c. Approved equal.

2. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 (DN 80) and smaller.

a. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
b. End Connections: Threaded.

E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Perfection Corporation.
b. Precision Plumbing Products, Inc.
c. Victaulic Company; or
d. Approved equal.

2. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

a. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
b. End Connections: Threaded or grooved.

2.3 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Division 22 Section "Common Work Results for Plumbing."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.4 IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

B. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

C. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.

D. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers, extending 360 degrees around pipe at each location.

E. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

F. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

G. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils (0.08 mm) thick.

1. Width: 1-1/2 inches (40 mm) on pipes with OD, including insulation, less than 6 inches (150 mm); 2-1/2 inches (65 mm) for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

H. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch (4-mm) hole for fastener.

1. Material: Valve manufacturer's standard solid plastic.
2. Size: 1-1/2 inches (40 mm) in diameter, unless otherwise indicated.
3. Shape: As indicated for each piping system.

I. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

J. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
2. Thickness: 1/16 inch (1.6 mm), unless otherwise indicated.
3. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

K. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Brown: Energy reclamation equipment and components.
4. Blue: Equipment and components that do not meet criteria above.
5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
6. Terminology: Match schedules as closely as possible. Include the following:

a. Name and plan number.
b. Equipment service.
c. Design capacity.
d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.

2.5 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 (DN 50) and Smaller: Dielectric unions.
2. NPS 2-1/2 (DN 65) and Larger: Dielectric flanges.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 (DN 50) and Smaller: Dielectric couplings or dielectric nipples.
2. NPS 2-1/2 (DN 65) and Larger: Dielectric nipples.

3.2 PIPING INSTALLATION

A. Install piping according to the following requirements and Division 33 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

    a. PVC Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
    b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 33 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.5 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
2. Locate pipe markers on exposed piping according to the following:

    a. Near each valve and control device.
    b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
    c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
    d. At manholes and similar access points that permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4 inch (6.4 mm) high for name of unit if viewing distance is less than 24 inches (610 mm), 1/2 inch (13 mm) high for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.9 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 330500

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Manholes.
3. Cleanouts.
4. Nonpressure transition couplings.
5. Stormwater inlets.
6. Pipe outlets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
3. Pipe outlets: Include plans, elevations, sections and details for concrete headwalls.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet (1:500) and vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

C. Product Certificates: For each type of pipe and fitting, from manufacturer.

D. Field quality-control reports.

1.4 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without [Architect's written permission.

PART 2 - PRODUCTS

2.1 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).

1. Bell-and-spigot ends and gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets
2. Class III.

2.2 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.3 CLEANOUTS

A. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 MANHOLES

A. Standard Precast Concrete Manholes in conformance with New Jersey Department of Transportation (NJDOT) Standard Specifications for Road and Bridge Construction, 2007 Edition.

B. Manhole Frames and Covers shall be in conformance with New Jersey Department of Transportation (NJDOT) Standard Specifications for Road and Bridge Construction, 2007 Edition.

2.5 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.6 STORMWATER INLETS

A. All inlets shall be in conformance with New Jersey Department of Transportation (NJDOT) Standard Specifications for Road and Bridge Construction, 2016 Edition.

B. Frames and Grates shall be in conformance with New Jersey Department of Transportation (NJDOT) Standard Specifications for Road and Bridge Construction, 2016 Edition.

2.7 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Stone Size as shown on Construction Plans.

2.8 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

2.9 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
3. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

2.10 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
2. Join dissimilar pipe materials with nonpressure-type flexible couplings.

2.11 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

2.12 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

2.13 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

2.14 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

2.15 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
    b. Option: Test plastic piping according to ASTM F 1417.
    c. Option: Test concrete piping according to ASTM C 924 (ASTM C 924M).

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 334100

SECTION 3346233 – MODULAR STORMWATER STORAGE UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, technical specification and general provisions of the Contract as modified herein apply to this section.

1.2 DESCRIPTION OF WORK INCLUDED

A. Provide excavation and base preparation per geotechnical engineer's recommendations and/or as shown on the design drawings, to provide adequate support for project design loads and safety from excavation sidewall collapse. Excavations shall be in accordance with the owner's and OSHA requirements.

B. Provide and install R-Tank^{HD}, R-Tank^{SD}, R-Tank^{MD}, R-Tank^{UD}, or R-Tank^{XD} system (hereafter called R-Tank) and all related products including fill materials, geotextiles, geogrids, inlet and outlet pipe with connections per the manufacturer's installation guidelines provided in this section.

C. Provide and construct the cover of the R-Tank system including; stone backfill, structural fill cover, and pavement section as specified.

D. Protect R-Tank system from construction traffic after installation until completion of all construction activity in the installation area.

1.3 REFERENCES

A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

B. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

C. ASTM F2418 - Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers.

D. Manufacturer's product literature and guidelines for R-Tank product.

1.4 QUALITY CONTROL

A. All materials shall be manufactured in ISO certified facilities.

B. Installation Contractor shall demonstrate the following experience:

C. A minimum of three R-Tank or equivalent projects completed within 2 years; and,

D. A minimum of 25,000 cubic feet of storage volume completed within 2 years.

E. Contractor experience requirement may be waived if the manufacturer's representative provides on-site training and review during construction.

F. Installation Contractor shall demonstrate knowledge and experience in the installation of subsurface storage system. Work shall be performed only by skilled workers with experience in bulk earthworks, pipe, chamber, or pond/landfill construction projects of comparable size and quality.

G. Installation Personnel: Performed only by skilled workers with satisfactory record of performance on bulk earthworks, pipe, chamber, or pond/landfill construction projects of comparable size and quality.

H. Contractor must have manufacturer's representative available for site review if requested by Owner.

1.5 SUBMITTALS

A. Submit proposed R-Tank layout drawings. Drawings shall include typical section details as well as the required base elevation of stone and tanks, minimum cover requirements and tank configuration.

B. Submit manufacturer's product data, including compressive strength and unit weight.

C. Submit manufacturer's installation instructions.

D. Submit R-Tank sample for review. Reviewed and accepted samples will be returned to the Contractor.

E. Submit material certificates for geotextile, geogrid, base course and backfill materials.

F. Submit required experience and personnel requirements as specified in Section 1.03.

G. Any proposed equal alternative product substitution to this specification must be submitted for review and approved prior to bid opening. Review package should include third party reviewed performance data that meets or exceeds criteria in Table 2.01 B.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect R-Tank and other materials from damage during delivery, and store UV sensitive materials under tarp to protect from sunlight when time from delivery to installation exceeds two weeks. Storage of materials should be on smooth surfaces, free from dirt, mud and debris.

B. Handling is to be performed with equipment appropriate to the materials and site conditions, and may include hand, handcart, forklifts, extension lifts, etc.

C. Cold weather:

1. Care must be taken when handling plastics when air temperature is 40 degrees or below as plastic becomes brittle.

2. Do not use frozen materials or materials mixed or coated with ice or frost.

3. Do not build on frozen ground or wet, saturated or muddy subgrade.

1.7 PREINSTALLATION CONFERENCE.

A. Prior to the start of the installation, a preinstallation conference shall occur with the representatives from the design team, the general contractor, the excavation contractor, the R-Tank installation contractor, and the manufacturer's representative.

B. The pre-installation conference shall review the layout drawings, pre-construction checklist, and discuss key steps of the process. The pre-construction checklist shall be signed and dated by all participants.

1.8 PROJECT CONDITIONS

A. Coordinate installation for the R-Tank system with other on-site activities to eliminate all non-installation related construction traffic over the completed R-Tank system. No loads heavier than the design loads shall be allowed over the system, and in no case shall loads higher than a standard AASHTO HS20 (or HS25, depending on design criteria) load be allowed on the system at any time.

B. Protect adjacent work from damage during R-Tank system installation.

C. Provide proper sediment controls to prevent sediment intrusion, if the system is operational during construction.

D. All pre-treatment systems to remove debris and heavy sediments must be in place and functional prior to operation of the R-Tank system. Additional pretreatment measures may be needed if unit is operational during construction due to increased sediment loads.

E. Contractor is responsible for any damage to the system during construction.

PART 2 - PRODUCTS

2.1 R-TANK UNITS

A. R -Tank - Injection molded plastic tank plates assembled to form a 95% void modular structure of predesigned height (custom for each project).

B. R-Tank units shall meet the following Physical & Chemical Characteristics:

PROPERTY	DESCRIPTION	R-Tank^{HD} VALUE	R-Tank^{SD} VALUE	R-Tank^{MD} VALUE	R-Tank^{UD} VALUE	R-Tank^{XD} VALUE
Void Area	Volume available for water storage	95%	95%	95%	95%	90%
Surface Void Area	Percentage of exterior available for infiltration	90%	90%	90%	90%	90%
Vertical Compressive Strength	ASTM D 2412 / ASTM F 2418	33.0 psi	42.0 psi	64.0 psi	134.0 psi	220.0 psi
Lateral Compressive Strength	ASTM D 2412 / ASTM F 2418	20.0 psi	22.0 psi	35.0 psi	19.0 psi	N/A
HS-20 Minimum Cover	Cover required to support HS-20 loads	20”	18”	15”	12”	6”
Maximum Cover	Maximum allowable cover depth	< 7 feet	< 10 feet	< 10 feet	< 7 feet	< 10 feet
Unit Weight	Weight of plastic per cubic foot of tank	3.62 lbs/cf	3.96 lbs/cf	3.53 lbs/cf	4.33 lbs/cf	7.55 lbs/cf

C. Supplier: Ferguson Waterworks, 507 Oak Glen Road, Howell Township, NJ, C: (610) 656-5640 https://www.fergusonwaterworks.com/

2.2 GEOSYNTHETICS

A. Geotextile. A geotextile envelope is required to prevent backfill material from entering the R-Tank modules.

1. Standard Application: The standard geotextile shall be an 8 oz per square yard nonwoven geotextile (ACF N080 or equivalent).

2. Infiltration Applications: When water must infiltrate/exfiltrate through the geotextile as a function of the system design, a woven monofilament (ACF M200 or equivalent) shall be used.

3. Lined Applications: When water must be retained within the tanks to prevent infiltration/exfiltration, an impermeable liner shall be used. The liner material and thickness shall be specified by the project design engineer. This liner should be installed per liner manufacturer specifications and industry accepted techniques.

B. Geogrid. For installations subject to traffic loads and/or when required by project plans, install geogrid (ACF BX12 or equivalent) to reinforce backfill above the R-Tank system. Geogrid is not always required for R-Tank^{XD} installations, and is often not required for non-traffic load applications.

2.3 BACKFILL & COVER MATERIALS

A. All materials shall be free from lumps, debris, and any sharp objects that could cut the geotextile.

B. Bedding Materials**:** Stone (angular and smaller than 1.5” in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used below the R-Tank system (3” minimum and 12” maximum). Material must be free from lumps, debris, and any sharp objects that could cut the

geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation. For infiltration applications bedding material shall be free draining.

C. Side and Top Backfill: Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

1. Traffic Applications - Free draining material shall be used adjacent to (24" minimum) and above (for the first 12") the R-Tank system.

a. For HD, and SD modules, backfill materials shall be free draining stone (angular and smaller than 1.5" in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System).
b. For UD modules with less than 14" of top cover, backfill materials shall be free draining stone (angular and smaller than 1.5" in diameter). The use of soil backfill on the sides and top of the UD module is not permitted unless the modules are installed outside of traffic areas or with cover depths of 14" or more. Top backfill material (from top of module to bottom of pavement base or 12" maximum) must be consistent with side backfill.

D. Non-Traffic / Green Space Applications - For all R-Tank modules installed in green spaces and not subjected to vehicular loads, backfill materials may either follow the guidelines for Traffic Applications above, or the top backfill layer (12" minimum) may consist of AASHTO #57 stone blended with 30-40% (by volume) topsoil to aid in establishing vegetation.

E. Biofiltration / Bioretention Applications - Backfill materials shall be in accordance with the cross-section for the specific biofiltration/bioretention application and media. A layer of bridging stone shall separate the soil media from the R-Tank units.

F. Additional Cover Materials: Structural Fill shall consist of granular materials meeting the gradational requirements of SM, SP, SW, GM, GP or GW as classified by the Unified Soil Classification System. Structural fill shall have a maximum of 25 percent passing the No. 200 sieve, shall have a maximum clay content of 10 percent and a maximum Plasticity Index of 4. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

2.4 OTHER MATERIALS

A. Utility Marker: Install metallic tape at corners of R-Tank system to mark the area for future utility detection.

PART 3 - EXECUTION

3.1 ASSEMBLY OF R-TANK UNITS

A. Assembly of modules shall be performed in accordance with the R-Tank Installation Manual, Section 2.

3.2 LAYOUT AND EXCAVATION

A. Verify the site conditions are suitable for product storage and installation per guidelines.

B. All excavations must meet OSHA safety standards for slopes or shoring.

C. Installer shall stake out, excavate, and prepare the subgrade area to the required plan grades and dimensions, ensuring that the excavation is at least 2 feet greater than R-Tank dimensions in each direction allowing for installation of geotextile filter fabric, R-Tank modules, and free draining backfill materials.

D. All excavations must be prepared with OSHA approved excavated sides and sufficient working space.

E. Protect partially completed installation against damage from other construction traffic by establishing a perimeter with high visibility construction tape, fencing, barricades, or other means until construction is complete.

F. Base of the excavation shall be uniform, level, and free of lumps or debris and soft or yielding subgrade areas. A minimum 2,000 pounds per square foot bearing capacity is required.

1. Standard Applications: Compact subgrade to a minimum of 95% of Standard Proctor (ASTM D698) density or as required by the Owner's engineer.
2. Infiltration Applications: Subgrade shall be prepared in accordance with the contract documents. Compaction of subgrade should not be performed in infiltration applications.

G. Unsuitable Soils or Conditions: All questions about the base of the excavation shall be directed to the owner's engineer, who will approve the subgrade conditions prior to placement of stone. The owner's engineer shall determine the required bearing capacity of the R-Tank subgrade; however in no case shall a bearing capacity of less than 2,000 pounds per square foot be provided.

1. If unsuitable soils are encountered at the subgrade, or if the subgrade is pumping or appears excessively soft, repair the area in accordance with contract documents and/or as directed by the owner's engineer.

2. If indications of the water table are observed during excavation, the engineer shall be contacted to provide recommendations.

3. Do not start installation of the R-Tank system until unsatisfactory subgrade conditions are corrected and the subgrade conditions are accepted by the owner's engineer.

3.3 PREPARATION OF BASE

A. Where a geotextile wrap is specified between the native soil and stone base, cut strips to length, and install in excavation, removing wrinkles so material lays flat.

1. Overlap geotextile a minimum 12" or as recommended by manufacturer. Use tape, special adhesives, sandbags, or other ballast to secure overlaps.

2. Where an impervious liner is specified, install the liner per manufacturer's recommendations and the contract documents. The liner should be sandwiched between layers of non-woven geotextile at a minimum.

3. As geotextiles can be damaged by extreme heat, smoking is not permissible on/near the geotextile, and tools using a flame to tack the overlaps, such as propane torches, are prohibited.

B. Place a thin layer (3" unless otherwise specified) of bedding material (Section 2.03A), within ½" (+/- ¼") of level or as shown on the plans. Vibratory tamp or static roll to prepare bedding materials until they are firm and unyielding.

C. Outline the footprint of the R-Tank system on the excavation floor using spray paint or chalk line to ensure a 2' perimeter is available around the R-Tank system for proper installation and compaction of backfill.

3.4 LAYOUT AND INSTALLATION OF THE R-TANKS

A. Where a geotextile wrap is specified on the stone base, cut strips to length and install in excavation, removing wrinkles so material lays flat. Overlap geotextile a minimum 12" or as recommended by manufacturer. Use tape, special adhesives, sandbags or other ballast to secure overlaps. As geotextiles can be damaged by extreme heat, smoking is not permissible on/near the geotextile, and tools using a flame to tack the overlaps, such as propane torches, are prohibited.

B. Where an impervious liner (for containment) is specified, install the liner per manufacturer's recommendations and the contract documents. The R-Tank units shall be separated from impervious liner by a non-woven geotextile fabric installed accordance with Section 3.04A.

C. Install R-Tank modules by placing side by side, in accordance with the design drawings. No lateral connections are required. It is advisable to use a string line to form square corners and straight edges along the perimeter of the R-Tank system. The modules are to be oriented as per the design drawing with required depth as shown on plans.

1. For HD and SD installations, the large side plate of the tank should be placed on the perimeter of the system. This will typically require that the two ends of the tank area will have a row of tanks placed perpendicular to all other tanks. If this is not shown in the construction drawings, it is a simple field adjustment that will have minimal effect on the overall system footprint. Refer to R-Tank Installation Guide for more details

2. For MD, UD and XD installations, there is no perpendicular end row required.

3. For MD installation, external side panels shall be installed around the perimeter of the system. Stacking clips shall be installed in each tier and each direction, as shown on design drawing details.
4. For XD installations, install stacking clips as specified in design drawings.

D. Wrap the R-Tank top and sides in specified geotextile. Cut strips of geotextile so that it will cover the sides and top, encapsulating the entire system to prevent backfill entry into the system. Overlap geotextile 12" or as recommended by manufacturer. Take great care to avoid damage to geotextile (and, if specified, impervious liner) during placement.

E. Identify locations of inlet, outlet and any other penetrations of the geotextile (and optional liner). These connections should be installed flush (butted up to the R-Tank) and the geotextile fabric shall be cut to enable hydraulic continuity between the connections and the R-Tank units. These connections shall be secured using pipe boots with stainless steel pipe clamps. Support pipe in trenches during backfill operations to prevent pipe from settling and damaging the geotextile, impervious liner (if specified) or pipe. Connecting pipes at 90 degree angles facilitates construction, unless otherwise specified. Ensure end of pipe is installed snug against R-Tank system.

F. Install Inspection and Maintenance Ports in locations noted on plans. At a minimum one maintenance port shall be installed within 10' of each inlet & outlet connection, and with a maximum spacing of one maintenance port for every 2,500 square feet. Install all ports as noted in the R-Tank Installation Guide.

G. If required, install ventilation pipes and vents as specified on drawings to provide ventilation for proper hydraulic performance. The number of pipes and vents will depend on the size of the system. Vents are often installed using a 90 degree elbow with PVC pipe into a landscaped area with 'U" bend or venting bollard to inhibit the ingress of debris. A ground level concrete or steel cover can be used.

3.5 BACKFILLING OF THE R-TANK UNITS

A. Backfill and fill with recommended materials as follows:

1. Place freely draining backfill materials (Section 2.03 B) around the perimeter in lifts with a maximum thickness of 12". Each lift shall be placed around the entire perimeter such that each lift is no more than 24" higher than the side backfill along any other location on the perimeter of the R-Tank system. No fill shall be placed over top of tanks until the side backfill has been completed.

2. Each lift shall be compacted at the specified moisture content to a minimum of 95% of the Standard Proctor Density until no further densification is observed (for self-compacting stone materials). The side lifts must be compacted with walk behind compaction equipment. Even when "self-compacting" backfill materials are selected, a walk behind vibratory compactor must be used.

3. Take care to ensure that the compaction process does not allow the machinery to come into contact with the modules due to the potential for damage to the geotextile and R-Tank units.

4. No compaction equipment is permissible to operate directly on the R-Tank modules.

5. Top Backfill: Only low pressure track vehicles shall be operated over the R-Tank system during construction. Dump Trucks and Pans shall not be operated within the R-Tank system footprint at any time. Heavy equipment should unload in an area adjacent to the R-Tank system and the material should be moved over the system using tracked equipment with an operating weight of less than 10 tons.

    a. Typical Applications: Install a 12" (or as shown on plans) lift of freely draining material (Section 2.03 B) over the R-Tank Units, maintaining 12" between equipment tracks and R-Tank System. Lightly compacted using a walk-behind trench roller. Alternately, a roller (maximum gross vehicle weight of 6 tons) may be used. Roller must remain in static mode until a minimum of 24" of cover has been placed over the modules. Sheep foot rollers should not be used.

    b. Shallow Applications (< 18" total cover): Install top backfill in accordance with plans.

6. If required, install a geogrid as shown on plans. Geogrid shall extend a minimum of 3 feet beyond the limits of the excavation wall.

7. Following placement and compaction of the initial cover, subsequent lifts of structural fill (Section 2.03 C) shall be placed at the specified moisture content and compacted to a minimum of 95% of the Standard Proctor Density and shall cover the entire footprint of the R-Tank system. During placement of fill above the system, unless otherwise specified, a uniform elevation of fill shall be maintained to within 12" across the footprint of the R-Tank system. Do not exceed maximum cover depths listed in Table 2.01 B.

8. Place additional layers of geotextile and/or geogrid at elevations as specified in the design details. Each layer of geosynthetic reinforcement placed above the R-Tank system shall extend a minimum of 3 feet beyond the limits of the excavation wall.

B. Ensure that all unrelated construction traffic is kept away from the limits of excavation until the project is complete and final surface materials are in place. No non-installation related loading should be allowed over the R-Tank system until the final design section has been constructed (including pavement).

C. Place surfacing materials, such as groundcovers (no large trees), or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.

D. Backfill depth over R-Tank system must be within the limitations shown in the table in Section 2.01 B. If the total backfill depth does not comply with this table, contact engineer or manufacturer's representative for assistance.

3.6 MAINTENANCE REQUIREMENTS

A. A routine maintenance effort is required to ensure proper performance of the R-Tank system. The Maintenance program should be focused on pretreatment systems. Ensuring these structures are clean and functioning properly will reduce the risk of contamination of the R-Tank system and stormwater released from the site. Pre-treatment systems shall be inspected yearly, or as directed by the regulatory agency and by the manufacturer (for proprietary systems). Maintain as needed using acceptable practices or following manufacturer's guidelines (for proprietary systems).

B. All inlet pipes and Inspection and/or Maintenance Ports in the R-Tank system will need to be inspected for accumulation of sediments at least quarterly through the first year of operation and at least yearly thereafter.

C. If sediment has accumulated to the level noted in the R-Tank Maintenance Guide or beyond a level acceptable to the Owner's engineer, the R-Tank system should be flushed.

D. All inspection and maintenance activities should be performed in accordance with the R-Tank Operation, Inspection & Maintenance Manual.

END OF SECTION 334623